FAIRCHILD
Space AND Defense systems

OPERATION & MAINTENANCE MANUAL

CHIP FORMAT PRINTER

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SECTION I

INTRODUCTION

SCOPE.

1-2. This manual provides an operational and maintenance guide for the Chip Format Printer. The manual contains a brief description of the Chip Format Printer, operational information, theory of operation, and troubleshooting and maintenance instructions.

1-3. BASIC CAPABILITIES.

1-4. The Chip Format Printer is a production rate, digitally-controlled, contact printer producing exposures of (1) a select target with the point of interest placed accurately with respect to the format fiducials within 0.3 mm in the roll or X direction, 0.2 mm in the Y direction, and 0.2 degree in azimuth (Θ), (2) a data block with up to 80 alphanumeric characters and 128 machine-readable digital words, and (3) a security designation on raw 4 x 5-inch film chips. The printer inserts these exposed chips into a development magazine.

1-5. Input information material for the Chip Format Printer is prephotointerpreted roll film (in 70 mm, 5 or 9-1/2-inch widths and up to 500-foot lengths) and a correlated digital input tape in ASCII code. The digital control tape contains information for target film position, security classification, number of chips to be printed and the accession number, or alphanumeric and machine-readable data block. This tape format is described in detail in paragraph 2-15. The Chip Format Printer also contains an Automatic Exposure Control System with a seven-stop manual override capability, a 10 power target film viewer and a 10 power view AEC sensor for AEC sampling of small select areas, a liquid gate for the reduction of degradation caused by input film scratches, internal vertical and longitudinal parity checks, manual controls for positioning of input target films used in conjunction with the servo positions counters and readouts as a mensuration device, and an automatic chip count control with manual override.

1-6. PHYSICAL DESCRIPTION.

1-7. The Chip Format Printer consists of two basic interconnected consoles with a digital link to a Model 35 ASR Teletypewriter. Shown in figure 1-1, the two consoles are the electronics console on the right and the print console on the left. The chip handling area, the print magazine, is mounted atop the print console and can be moved back from the print position a distance of approximately one foot so that the input film viewing area of the print console is accessible.

1-8. The Electronics console is separated into two functional sections. The front section (figure 1-2), accessible via the two front doors, contains 11 drawers of forced air cooled electronics consisting of digital circuitry, magnetic memory, bidirectional encoder counters, switching circuitry, X, Y and Θ axis servo electronics, AEC electronics, and various dc power supplies. The drawers are connector coupled to the main electronics console cabling. Mechanical cable retractors are provided on the console pendant cables. The rear section of the electronics console (figure 1-3) is accessible via the rear doors and contains the gate liquid reservoir, vacuum pump and accumulators, air lines, valves and regulators, liquid lines and valves, vacuum lines and valves, and fans for electronic cooling.

1-9. The print console, a rigid weldment, cable isolator mounted to reduce effect of external vibration, contains the target or input film transport, target film format masks, drain tray and sump for recovering excess gate liquid, and a high intensity exposure lamp for target exposures. The right side of the console contains the bulk of the electrically operated valves which control the flow of air, vacuum, and gate fluid. The left side of the console contains the high voltage supply for the Xenon exposure lamp which is mounted in the azimuth axis column. The four control panels, containing operator controls, readouts, and malfunction indicators are mounted on the upper front left and right of the print console.

1-10. The print magazine is the portion of the unit that houses the chip handling and printing functions. The basic magazine structure is a ribbed casting, ball bushing mounted atop the print console.

1-11. The primary chip handling mechanism is a rotating four stage turret with four extendable porous ceramic vacuum platens that carry unexposed chips in sequence through each of four positions. At position one, the chip drop position on the top of the print magazine, an

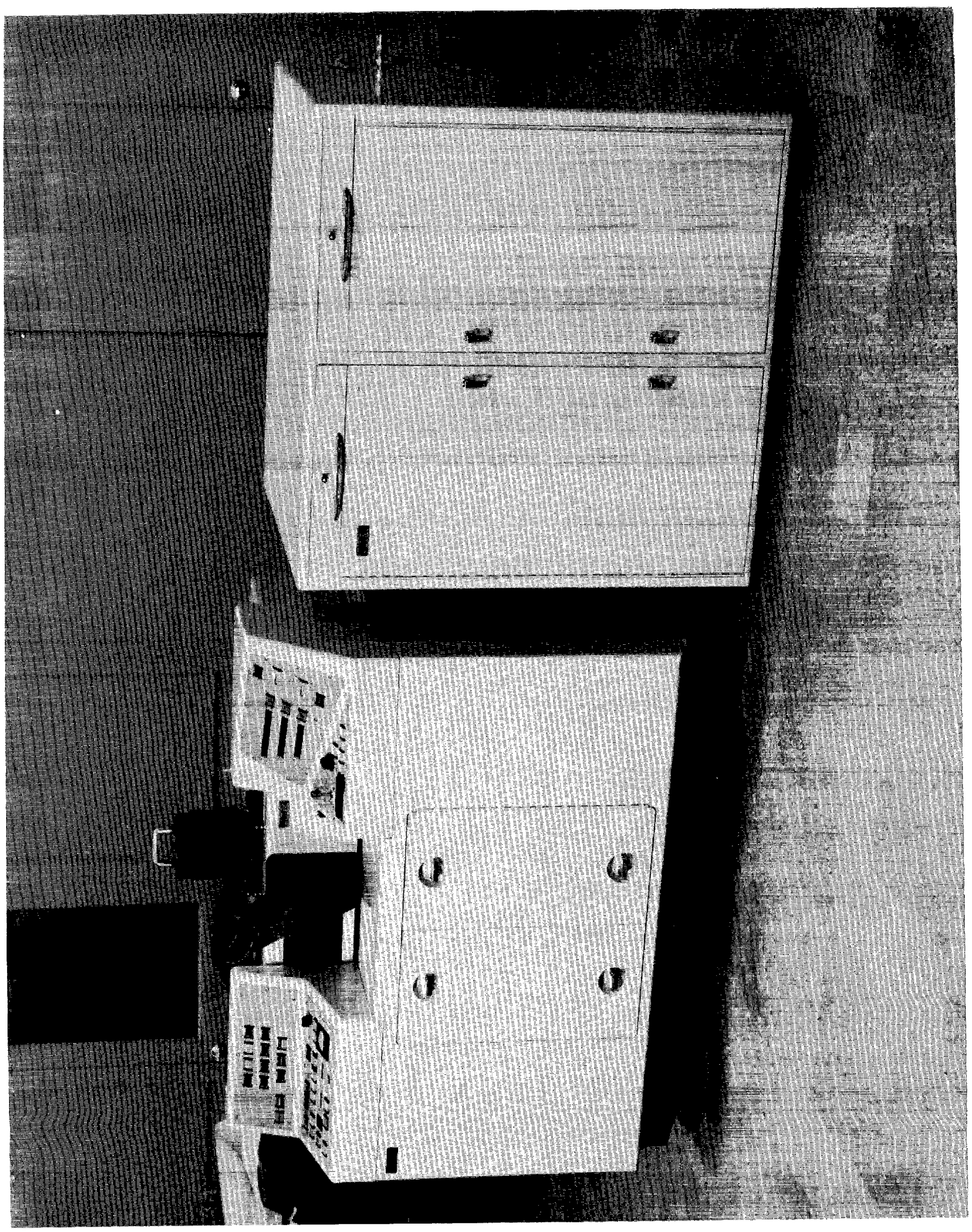

Figure 1-1. Chip Format Printer

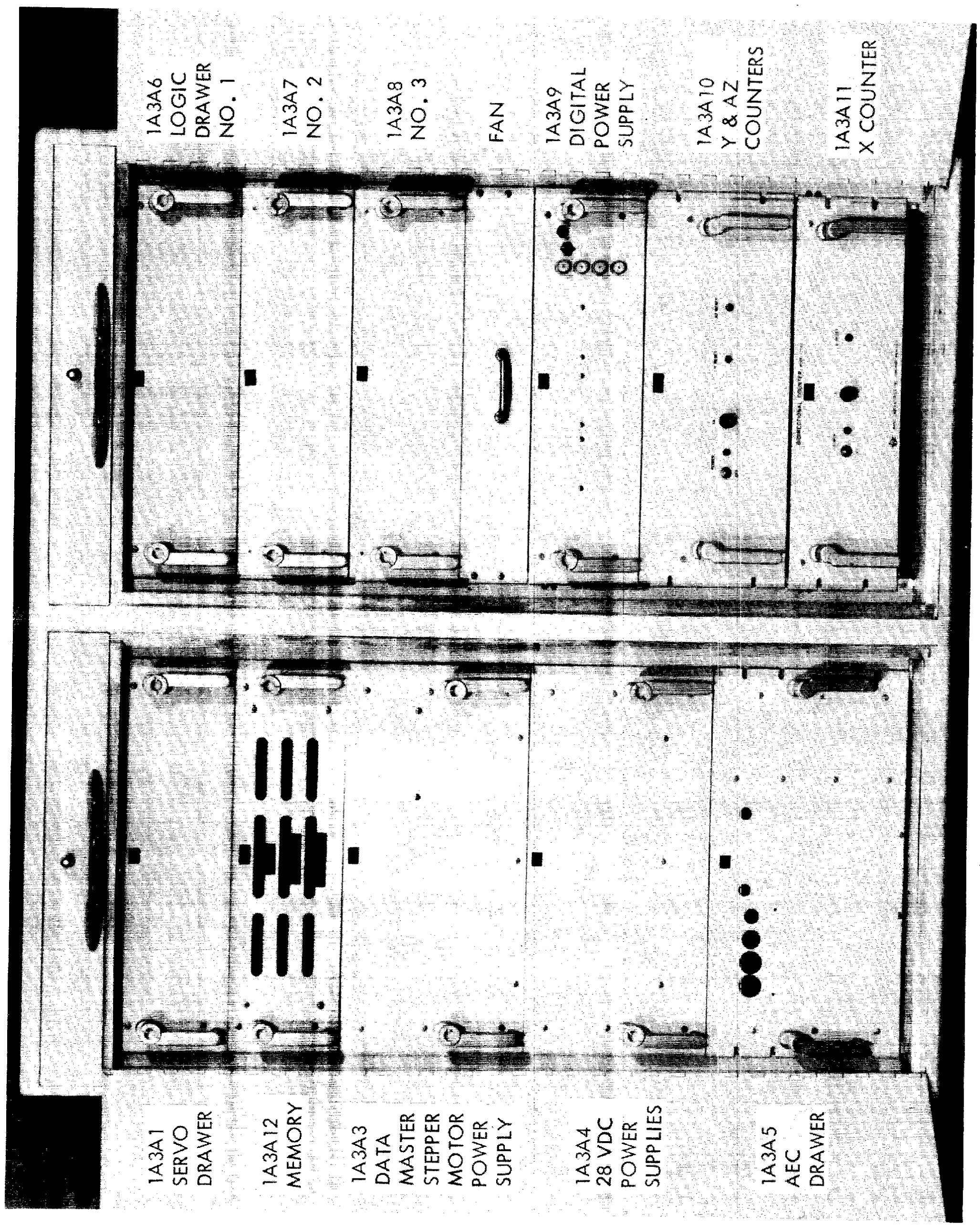

Figure 1-2. Electronics Console, Front View

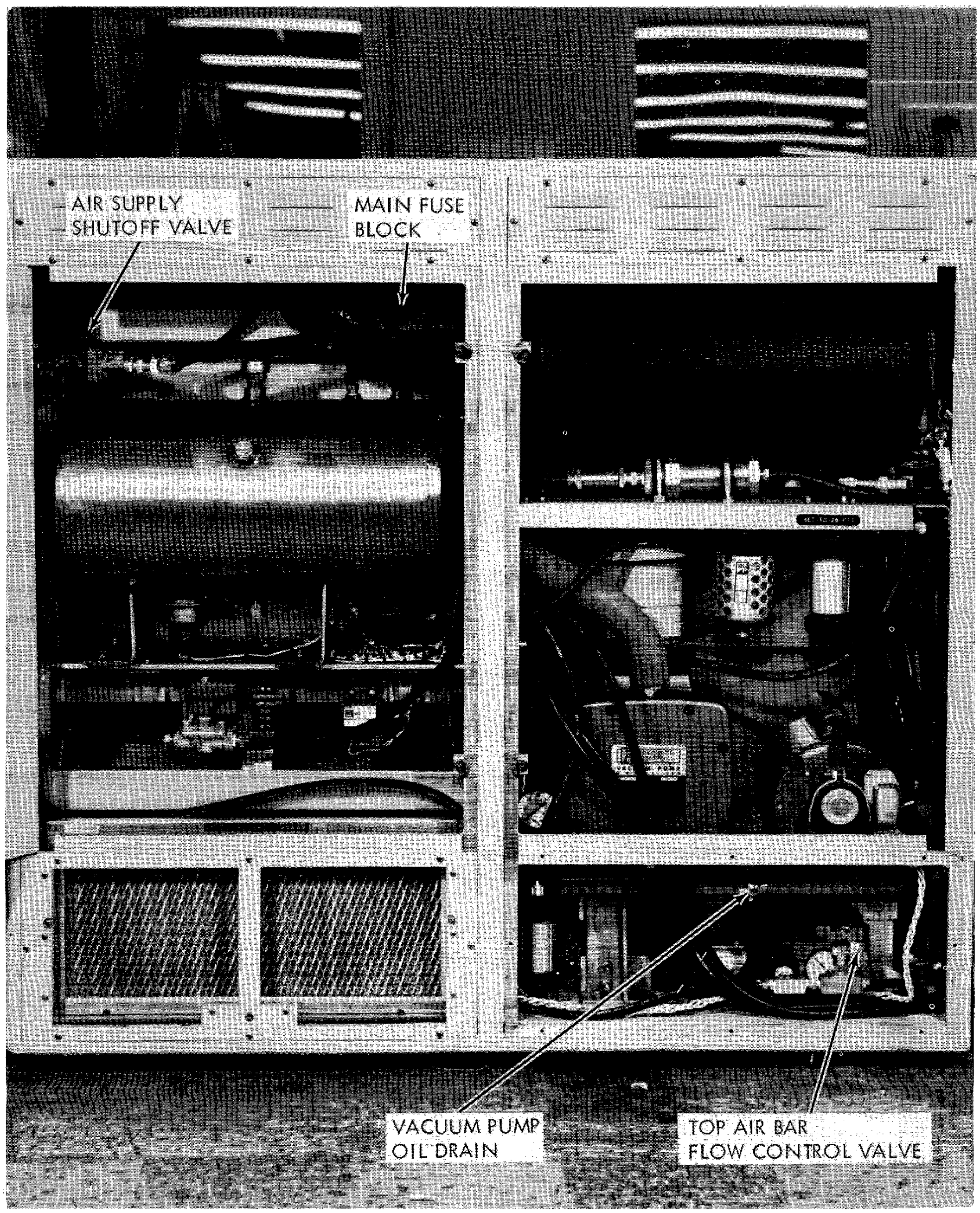

Figure 1-3. Electronics Console, Rear View

unexposed chip is dropped and picked up by a vacuum platen. The chip is carried to position two, the data print position at the rear of the print magazine, where a data block and security exposure are placed on the chip by the character generator and security classification mechanisms respectively. The chip is carried to position three, the target print position, where the chip is brought into contact with the input target film in the print console via an opening in the bottom of the print magazine, casting for a contact print of the target. Position three also contains the automatic exposure control sensing photocells mounted on sliding light-tight doors that close off the opening at position three when the unit is not printing. Position four, the chip eject position, contains mechanisms that catch and bow the chips as they are blown off the ceramic platen and then transport the chip into a holder dropped from a chip holder magazine. The chip and chip holder are inserted into a detachable development magazine on the left side of the print magazine.

1-12. Electronics for the control of the printing function and the character generator operation are mounted on the rear of the print magazine casting. A ten power viewer and AEC sensing photocell for viewing the input roll film are mounted on the front of the print magazine.

SECTION II

OPERATIONAL INFORMATION

2-1. PRELIMINARY SETUP.

2-2. Certain tasks should be performed before power is turned on in the unit. These will be described in the following paragraphs.

2-3. FORMAT MASK. There are two format masks supplied with the unit. One has a format of 55 mm x 116 mm and the other, 80 mm x 116 mm. The proper mask should be installed depending on which format size is desired. The masks are keyed so that they can be inserted only one way, and when properly installed they should be level and stable. Note that the three latches on the mask support should be fastened.

2-4. DISPENSING TANK FILLING. The dispensing tank is located at the rear of the electronics console on the left-hand side. Before opening the filling port, shut off the air pressure supply and vent any pressure in the tank by pulling up on the spring-loaded cap of the relief valve mounted on the top of the tank (figure 1-3). The easiest way to fill the tank is to place a five-gallon can of the gate liquid on top of the electronics console and siphon the contents into the dispensing tank. The tank holds five gallons <u>maximum</u>. To be certain that all the liquid in the system is in the dispensing tank before filling, turn the air and electrical power to the unit on for a few minutes to pump all the liquid which might be in the sump tank into the dispensing tank.

2-5. FILM LOADING. Rotate the film drive until the supply side is visible through the print console loading doors. Insert one of the supplied spindles into the film spool with the base side of the film in contact with the rollers; observe the loading diagram on the doors. Replace the lock nut and tighten. Before installing the spool on the film drive, pull the handle located on the right-hand side toward you. Place the spool in the film drive and push the handle back. Thread the film over the rollers according to the loading diagram (figure 2-1) and make certain to pass the film <u>under</u> the two flat air bars and over the two round air bars located on top.

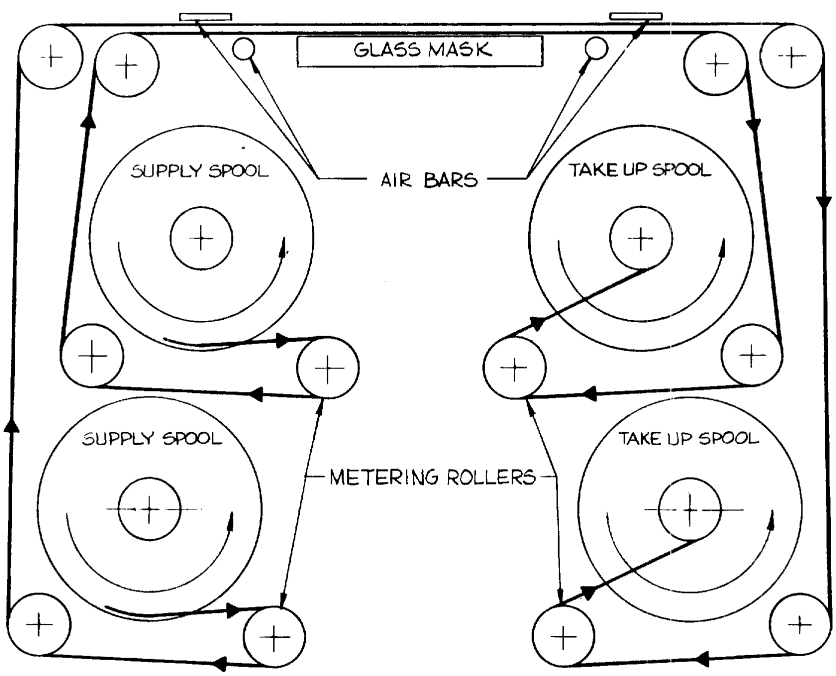

Figure 2-1. Film Drive Loading

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2-6. LIVE FILM LOADING. The following procedure must of course take place in the dark. A red safelight would facilitate loading. If there are any separating papers between the chips, they must be removed before the film is loaded into the cassette.

2-7. Place the empty cassette upright on a table with the small knob protruding from the side facing you. This is the inner chip container locking knob. Pull the locking knob straight out and simultaneously pull the top knob (inner chip container lifting knob) straight up. Release the locking knob and the lifting knob should remain fully extended (figure 2-2). Note the slot with the beveled insertion edge at the bottom of the cassette. This is to allow the insertion of the light trap so the loaded cassette can be safely carried in the light. Lay the cassette on its side and load the raw film into the cassette with the emulsion side facing in. Return the cassette to the upright position and insert the light trap. Do not attempt to lower the lifting knob while the light trap is in place (figure 2-3).

2-8. DATA MASTER LOADING. The data master carriage is readily accessible through the rear flap cover. Do not attempt to move this carriage manually without removing the screw in the locking pin that attaches the carriage to the drive tapes. This locking pin is a knurled device located on the bottom rear of the carriage (figure 2-4). Attempting to move the carriage without removing this pin will result in severe damage to the data master drive tapes.

2-9. To load a new roll of data master film it is necessary to first spool it onto the supply spool. This is accomplished by removing the supply spool and spooling the data master film off the cardboard shipping cores and onto the supply spool. For convenience, the shiny side of the film will be called the base, and the dull side will be called the emulsion. The data master film is comprised of two layers of the same material, layed emulsion to emulsion. The spooling can be accomplished by taking two rolls on their shipping cores, taping the ends together so that the film emulsions are in contact, and winding the film onto the supply spool from both shipping cores simultaneously. Install the freshly loaded supply spool into the data master carriage so that the film feeds in the manner shown on the loading diagram on the inside of the access cover. Thread the film over the rollers as indicated in the loading diagram (figure 2-5). If there is difficulty in threading the film over the rollers due to the close spacing, splice the new roll of film onto the old before the supply spool is completely empty.

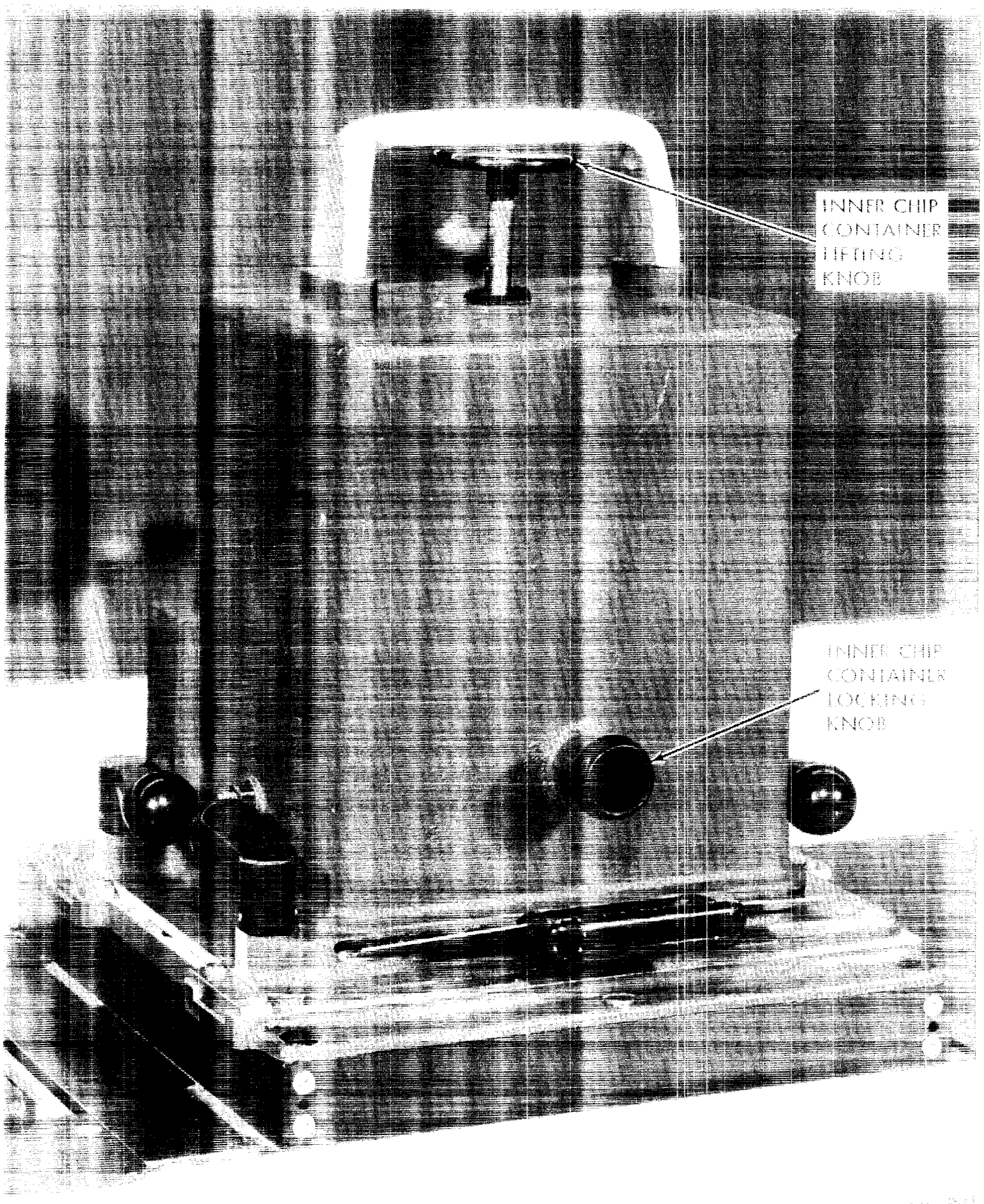

Figure 2-2. Chip Cassette in Carrying Position with Light Trap Installed

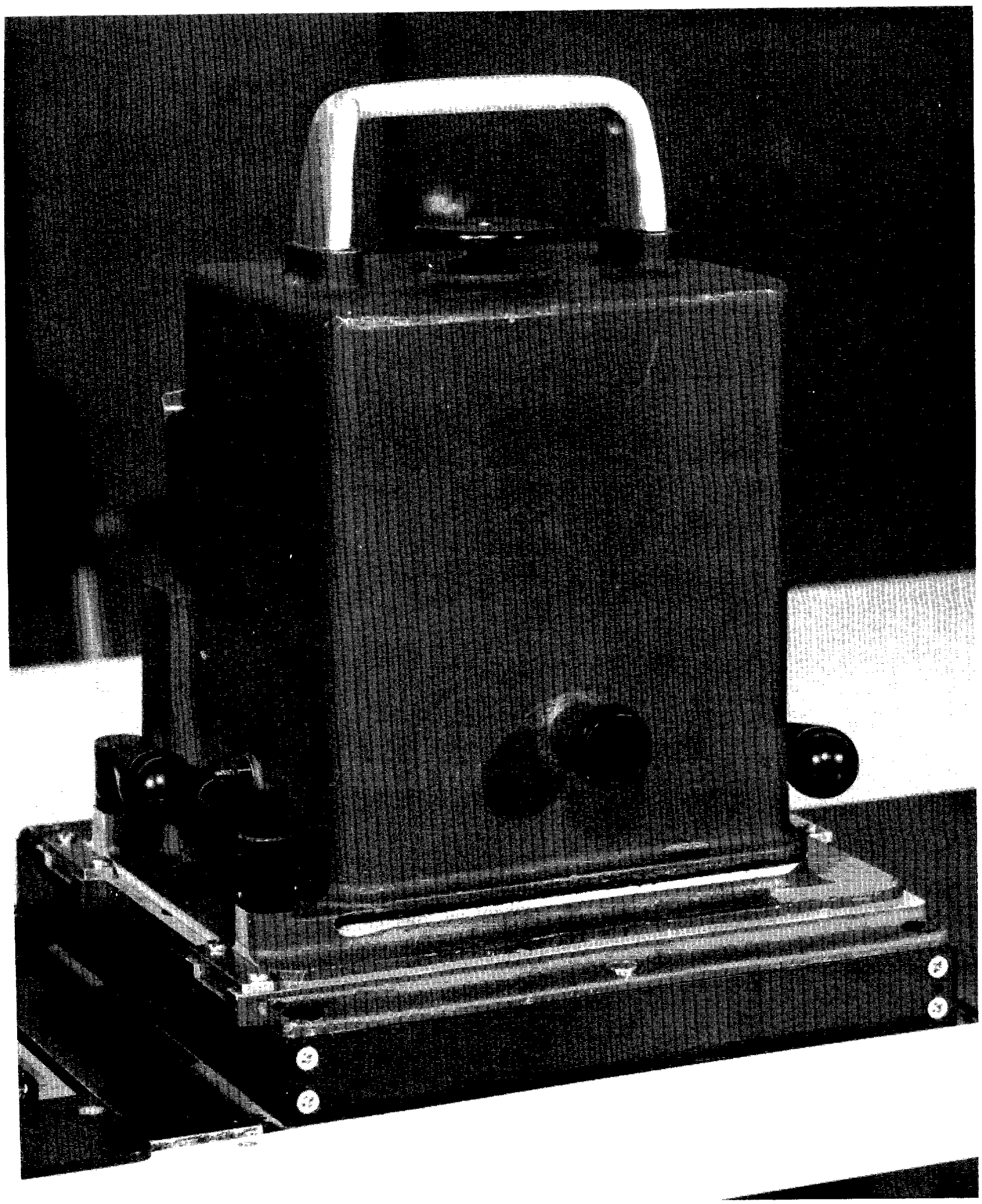

Figure 2-3. Chip Cassette in Operating Position

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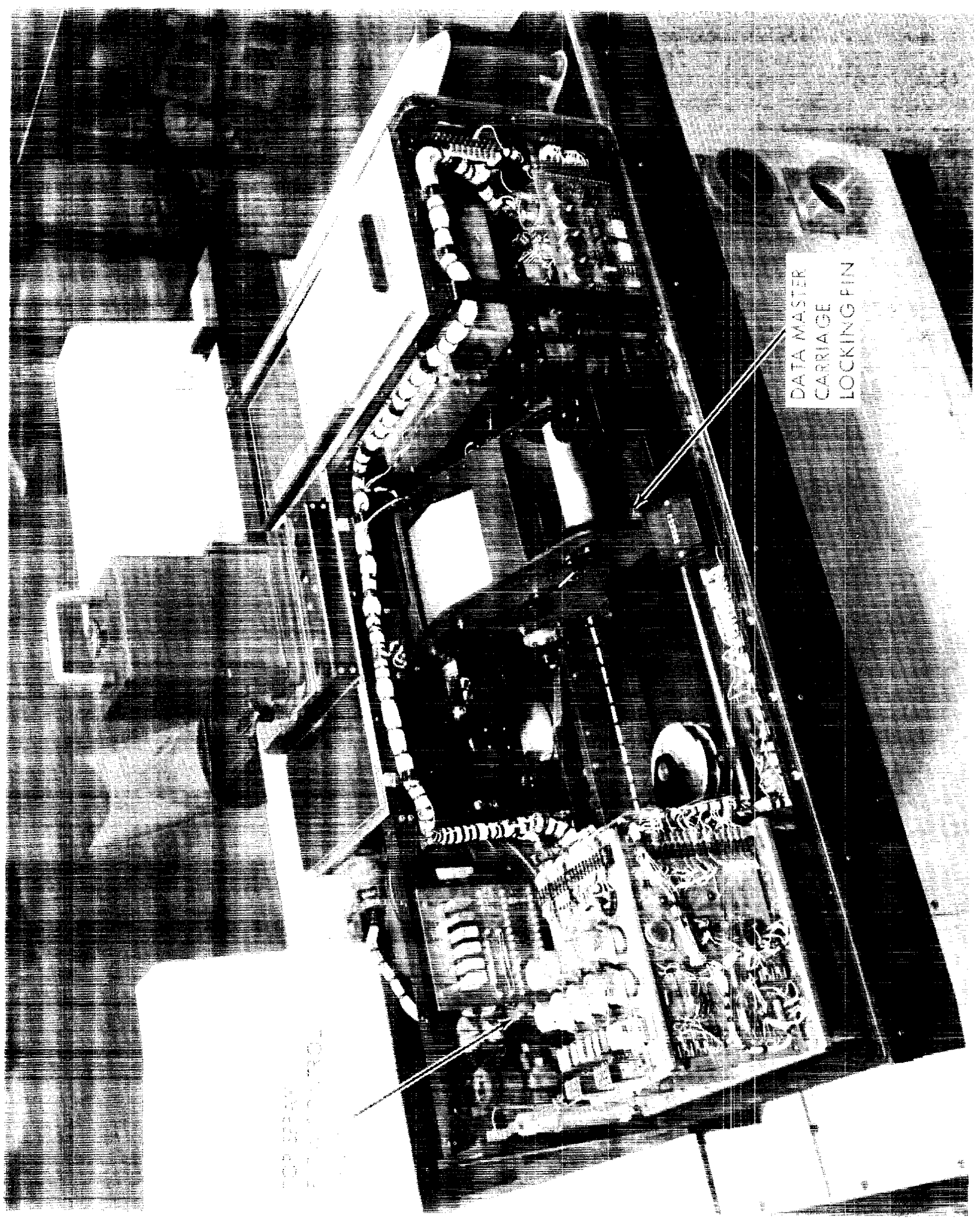

Figure 2-[illegible]. Print Magazine, Rear View

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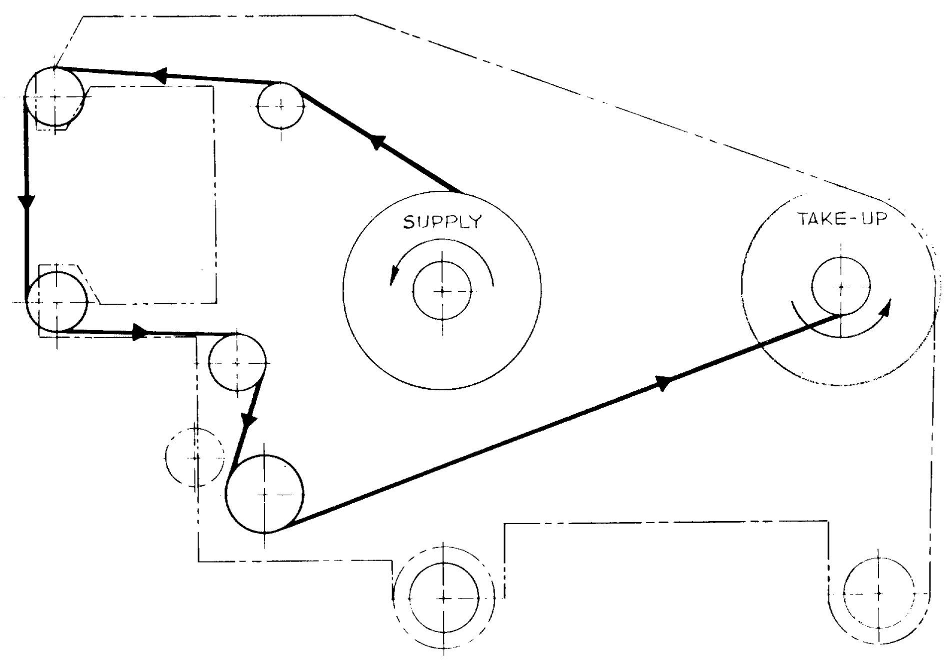

Figure 2-5. Data Master Loading

2-10. CHIP HOLDER SUPPLY. Slide back the chip holder supply access cover. Pull the pressure plate toward the rear of the unit. (All directions are given with the operator standing at the rear of the unit facing forward.) Load the chip holders in front of the pressure plate so that the silhouette of the chip holder, as viewed from the top, exactly matches the decal affixed to the chip holder supply access cover. That is, the hooks are to the left and the hook opening is towards the rear (figure 2-6). The number of chip holders loaded into the supply should not exceed 35.

2-11. TELETYPE OPERATION.

2-12. DESCRIPTION. Digital input information is supplied to the Chip Format Printer via a Model 35 Automatic Send-Receive (ASR) Teletypewriter Set manufactured by the Teletype Corporation, Skokie, Illinois. Operation of this teletype device requires a one-inch wide paper information tape (Friden type 1055605 or equivalent).

2-13. The Chip Format Printer is designed to accept the American Standard Code for Information Interchange (ASCII) from the teletype. The ASCII code is an eight level code, the eighth level of which is a vertical parity bit. Parity for the teletype and the Chip Format Printer is even. Power for the teletype and the printer is supplied separately. Turn on of the teletype is accomplished by placing the teletype mode switch to the LOC position. A pendant cable, terminated in a 24-pin connector is attached to the teletype to provide interface with the printer. This pendant is plugged into connector 1A3J2 on the right rear side of the printer electronic console at installation.

2-14. Installation, maintenance, and servicing information for the Model 35 ASR Teletype can be found in the Teletype Corporation Bulletin 280B, Volume 1 and Volume 2 and Bulletin 1187B.

2-15. PREPARATION OF PUNCH TAPE.

NOTE

The Chip Format Printer should not be turned on during punch tape preparation because the information will cause the servos to operate. The teletype unit should be installed and lubricated and contain punch tape and hard copy printout paper loaded as directed in Teletype Corporation Bulletin 208B, Volumes 1 and 2.

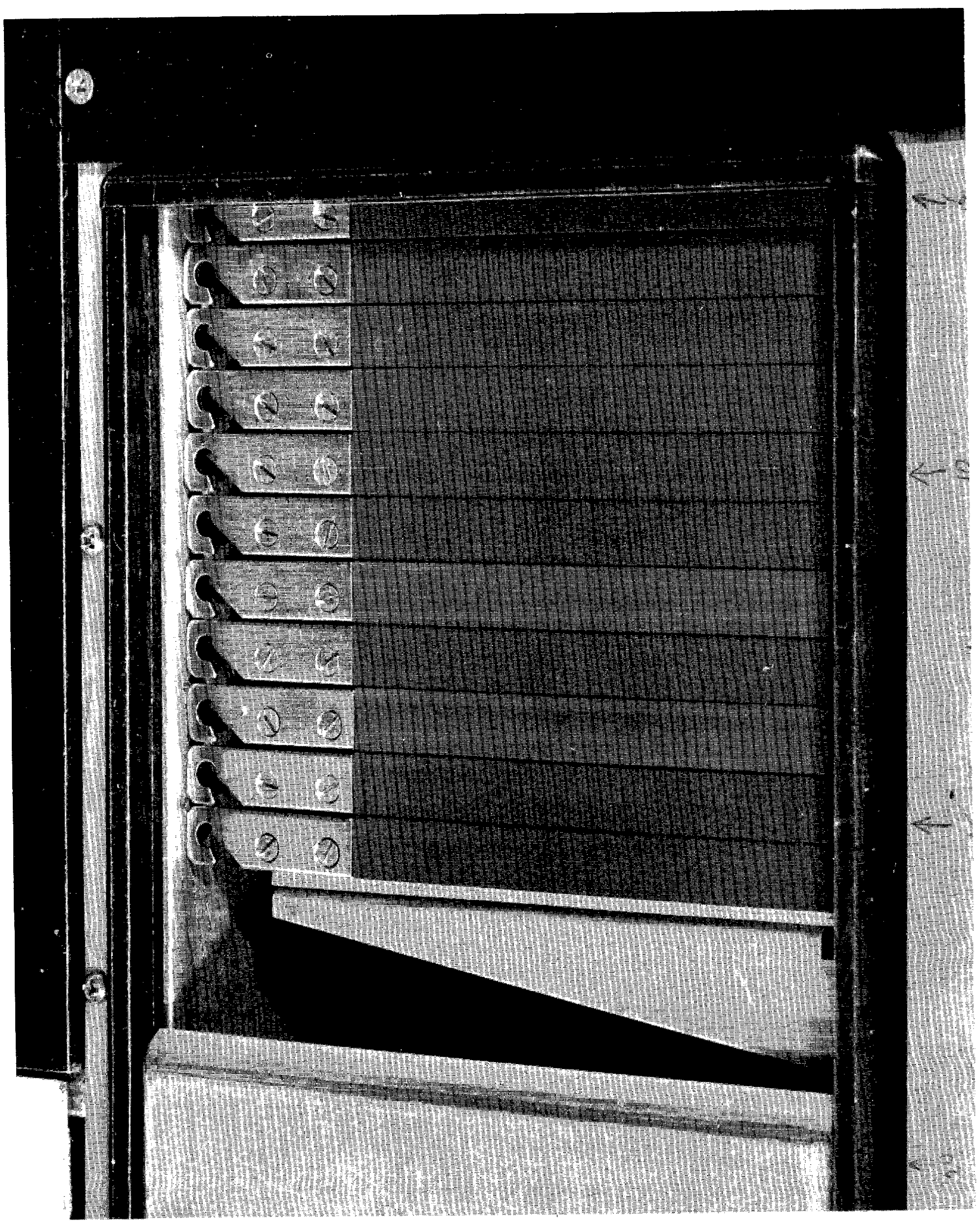

Figure 2-6. Chip Holder Orientation

2-16. The teletype unit should be turned on by placing the mode switch at LOC. The punch on switch should be momentarily depressed, and the program control switch should be placed in the off position. The SPACE BAR and REPT keys of the keyboard should be depressed to generate a series of spaces on the punch tape for a leader and for space for a keying or log number. Control information should then be punched on the tape using the format in table I.

TABLE I. TELETYPE FORMAT

TELETYPE FORMAT			Example	
Information Separator	-	One Character	-	Control Section of Tape
Sign Y	-	One Character	+	
Y Value	-	Four Characters	1258	
Information Separator	-	One Character	-	
Azimuth Value	-	Four Characters	1692	
Information Separator	-	One Character	-	
Sign X	-	One Character	+	
X Value	-	Five Characters	26371	
Information Separator	-	One Character	-	
Security Classification	-	Two Characters	11	
Information Separator	-	One Character	-	
Number of Prints	-	Two Characters	12	
Information Separator	-	One Character	-	
*Start of Message	-	One Character	-	Print Information Section of Tape
Installation Identifier	-	Two Characters	10	
Mission Identifier	-	Eleven Characters	903912A1206	
Date	-	Six Characters	181263	
Enlargement Factor	-	Two Characters	14	
Geographic Coordinates	-	Eleven Characters	6147N10132E	
Photo Frame Reference	-	Ten Characters	+2634-1258	
Orientation	-	Four Characters	1693	

TABLE I. TELETYPE FORMAT (cont)

TELETYPE FORMAT			Example	
Spaces Interspaced into the Above Data	-	Ten Characters	-	
*End of Address (EOA)	-	One Character	-	
Machine Readable Code	-	Sixty-eight Characters ~~Minimum~~ , MIN	-	Print Information Section of Tape
*End of Transmission (EOT)	-	One Character	-	
*MPC Parity Check	-	Three Characters	051	
*Stop Code (DC4)	-	One Character	-	

Note: Carriage return and line feed symbols will be supplied as needed by the computer.

*Indicates these codes must appear in this position.

2-17. All of the characters representing the 26 letters of the alphabet, the 10 decimal digits, plus sign (+), minus sign (-), period (.), space, carriage return and line feed are punched on the digital tape in conventional typewriter keyboard manner. The five control characters are punched by depressing the following sets of keys simultaneously:

Control Character	Keys
Start of Message (SOM)	CTRL and A
Stop Code (DC4)	CTRL and T
End of Transmission (EOT)	CTRL and D
End of Address (EOA)	CTRL and B
Information Separator (IS7)	CTRL, SHIFT AND O (letter)

IMPORTANT NOTES:

1. The order of the control portion of the tape format, plus SOM, EOA, EOT, master parity check, and stop codes must be strictly adhered to since the Chip Format Printer is internally programmed to receive information only in this sequence.

2. Decimal points or periods should not be inserted in the control section of the tape. Their position is internally programmed in the printer.

3. If a Y, X, or azimuth command number is not large enough to use all of the available character spaces in the tape format, the unused most significant digits must contain zeros (0). For example, the Y value in table I is +1258, representing a motion of +125.8 millimeters. If the desired Y value for motion was -5.8 millimeters, the Y value must read -0058.

4. The master parity check number represents the total of all digital words preceding (not including) itself. As in note 3, if the master parity number is under 100, that is, does not fill its most significant digit, the most significant digit should contain a zero.

2-18. INFORMATION READIN. The digital punch tape should be placed in the program tape reader by pressing the tape lid release button, inserting the tape between the tape guides, and then closing the tape lid. This operation must be done with the teletype mode switch in OFF. After tape insertion, turn the mode switch to LOC. All magazine and reservoir loading and initial alignment should have been completed previously. The input information is read in by momentarily depressing the TAPE READIN switch on the Chip Format Printer lower left control panel. This should only be done after the target film has been properly aligned to the fiducials.

NOTE

The TAPE READIN switch controls some necessary internal functions when depressed; hence, wherever a digital tape is read into the printer, the TAPE READIN switch on the printer, <u>not</u> the START switch on the teletype, must be used.

The digital tape will automatically stop at the end of the data block or at the occurrence of a parity error.

2-19. CONTROL PANEL OPERATION

2-20. DESCRIPTION OF SWITCH AND INDICATOR FUNCTIONS. Similar operational functions are generally grouped together on the same front panel. For example, the upper left front panel contains all the malfunction indicators. Any indicator illuminated in red signifies a malfunction of that particular function of the unit or an operator performance override. The lower left front panel contains switches and indicators for chip and exposure control. The upper right front panel contains the target film mensuration counters. The lower right front panel contains the controls for target film manual operation. The controls and indicators are illustrated in figures 2-7 through 2-9 and are described in table II.

TABLE II. CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION
UPPER LEFT FRONT PANEL (Figure 2-7)	
MAIN PWR switch	Applies 115 volts, 60 Hz to the unit when depressed, which activates the -12 vdc, +6 vdc and +19 vdc power supplies. The vacuum pump is turned on and the +28 vdc relay and solenoid power supply is fed to the front panels only.
STANDBY - ON switch	In the ON position, after a five-second delay, +28 vdc regulated and +28 vdc relay and solenoid power is distributed throughout the system. The unit is now ready to be operated.
CHIP CASS EMPTY indicator	Lights when the supply of chips in the cassette has been reduced to 0 to 25 chips depending on chip thickness. This indicator will only light during operation. This signifies that the supply of chips is very low.
MAG POS and MASK SIZE indicators	The magazine position indicator indicates the two possible magazine positions due to the two different format sizes (55 mm and 80 mm). The mask size indicator identifies which mask (55 mm or 80 mm)

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
MAG POS and MASK SIZE indicators (cont)	is in place. These two indicators are used in conjunction. When the magazine is in the wrong position for the mask that is installed, both indicators will illuminate red indicating the discrepancy. When the magazine is in the proper position, both indicators will illuminate green.
DATA MAST EMPTY indicator	Signifies that the data master film supply spool on the data master carriage is almost empty.
VAC indicator	Signifies that the pressure in the accumulator is above approximately 200 mm Hg. This is a malfunction.
LIQUID EMPTY indicator	Lights when there is approximately one liter of fluid left in the dispensing tank.
VENT indicator	Lights by an air flow switch in one of the exhaust ducts when there is failure of the exhaust fans in the print console.
DEV MAG FULL indicator	Signifies that the magazine is full and cannot accept any more chip holders. When the STANDBY-ON button is in STANDBY the DEV MAG FULL indicator will be lit at all times. This does not necessarily mean that the development magazine is full. During operation, the DEV MAG FULL indicator will flash. This is a normal condition. When this indicator remains on continuously, that signifies that the magazine is full.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
DATA LAMP FAIL indicator	Signifies that the data recording lamp has burned out. This will occur only during operation of the unit. After data recording lamp burnout and subsequent lamp replacement, this indicator will remain illuminated until the first print cycle, where upon it will extinguish, indicating all is well again.
PARITY ERROR indicator	When there is a word or vertical parity error during tape readin the VERT section of the PARITY ERROR will light. At the end of tape readin, if there is a master or longitudinal parity error the LONG section will light. This indicates that there is an error in the punch tape, or else the teletype transmitted the wrong information.
AIR-FILM DRY indicator	The AIR portion is a malfunction indicator and lights when the air pressure coming out of the main pressure regulator (which is set for 25 psi) falls below 15 psi. The FILM DRY portion is a switch that when depressed feeds air to the air bars underneath the target film. This function is used at the end of a run to dry the bottom of the film before it is rewound onto the film spools.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
LOWER LEFT FRONT PANEL (Figure 2-8)	
LOGIC RESET switch	A momentary switch used to reset all the digital logic. This switch does not reset the mensuration counters.
TAPE READIN switch	When depressed, starts the teletype tape reader to feed information to the memories. It also has a self-holding coil that keeps the switch depressed until the entire tape is read in or until the unit determines that there is a parity error.
SERVO POS COMPL indicator	Lights after the three servos (Y, θ, and X) have achieved their final position.
VIEW LAMP switch	Turns on the auxiliary viewing lamps under the format area.
EXP ERROR indicator	Lights whenever the AEC light reading exceeds the range of the AEC system. That is, the target film is either too dark or too light.
FILM TYPE switch	A six-position selector switch, four of which are unmarked and are for use with future chip types.
AEC VIEW switch	Switches two different light sensors into the AEC system depending on whether it is desired to have the large automatic sensors determine the light reading or the small sensor in the 10X viewer. In the 10X mode, the holding coil releases at the end of a run or when the AEC & PRINTS REQD switch is depressed to RESET TO AUTO.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
10X VIEW switch	When AEC VIEW switch is depressed to 10 X, it is necessary to press the 10X VIEW switch to take an AEC reading. This would be done only when the 10X viewer is positioned over the area where a light reading is desired. This switch has a holding coil, which will release five seconds after the switch is depressed.
EXPOSURE CONTROL switches	Consists of seven switches labeled +1, +2 etc. Depressing the +1 switch increases the normal exposure by 1 stop, +2 increases the exposure by 2 stops, etc. The same holds for the switches labeled - (minus) wherein the exposure would be decreased. These switches contain holding coils, which cause them to go back to NORMAL at the end of each run.
PRINTS REQD switch	In the AUTO position the punch tape via the teletype unit determines the number of chips that will be printed. When depressed to MAN, the number of prints is set in by the operator from the front panel. In the MAN mode there is a holding coil which releases at the end of a run or if the AEC & PRINTS REQD switch is depressed to RESET TO AUTO. Depressing LOGIC RESET will also release the holding coil, and the switch will return to the AUTO mode.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
NO PRINTS MAN switch	The number of prints manual thumbwheel switch is used when the print quantity is desired to be set from the front panel.
PRINTS PRINTED indicator	Indicates the actual number of chips that have been picked up by the platens to be printed.
PRINTS REQD readout	Indicates how many prints are to be made in any particular run. When the PRINTS REQD switch is in the AUTO position, the punch tape information from the teletype unit determines the number in the PRINTS REQD readout. When in MAN mode, the NO PRINTS MAN thumbwheel switch sets the number.
CHIP HOLDERS REMAINING meter	Indicates the number of chip holders left in the chip holder supply.
AEC & PRINTS REQD switch	When depressed, releases the holding coils in the AEC VIEW switch and the PRINTS REQD switch so that they reset to the AUTO mode.
GO - NO GO indicator	NO GO portion lights if any of the malfunction indicators are illuminated. If all functions are satisfactory, the NO GO portion will extinguish, but the GO section will not light until the servos have been properly positioned and the data master has been fully printed. The GO light indicates that printing can now take place.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
PRINT switch	Starts the printing cycle and remains lit only while the print cycle is in process.
ELAPSED TIME meter	Indicates the total time that the unit has been on.
UPPER RIGHT FRONT PANEL (Figure 2-9)	
MENSURATION counters	The X and Y counters indicate the travel in millimeters and the azimuth counter indicates rotation in degrees.
ZERO RESET switches	Reset the respective mensuration counters to read zero.
END OF FILM (upper) indicator	Lights when one film spool (either supply or takeup) is nearly empty. The illuminated arrow points to the spool that is nearly empty when the azimuth drive is in the zero position (see AZ POSITION). This indicator shows the end of film for the upper track only.
FILM FOOTAGE UPPER TRACK counter	This resettable counter indicates the length of film that has been transported on the upper track. The counter is capable of reversing itself so that no matter how far the film is transported or in what direction, any particular frame on the roll should always register the same footage reading on the counter. This counter indicates feet in 0.2-foot increments.
FILM FOOTAGE LOWER TRACK counter	Same as FILM FOOTAGE UPPER TRACK except that this counter indicates footage on the lower track.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
END OF FILM (lower) indicator	Same as END OF FILM (upper) except that this indicator shows end of film for the lower track.
LOWER RIGHT FRONT PANEL (Figure 2-9)	
BIAS TRIM	Adjusts the bias voltage which proportions the tension on the film spools. This adjustment is necessary to keep the film from creeping in the X direction.
Joystick	Adjusts the speed of the X and Y drives in the manual mode. It is necessary to depress the operation switch before the joystick has any control.
AZIMUTH	Adjusts the speed of the azimuth drive in the manual mode. It is necessary to depress the operation switch before the azimuth control has any effect.
MANUAL switch	Depressing this switch to either the FAST or SLOW position causes gross speed changes in the X, Y and azimuth drives in the manual mode.
Operation switch	Used in conjunction with the joystick and the AZIMUTH control. Depressing the operation switch allows these controls to come into play.
MANUAL SELECT switch	When depressed to X-Y, only the X and Y drives are operational in the manual mode. When depressed to AZ, only the azimuth drive is operational in the manual mode. All three drives cannot be operated simultaneously.

TABLE II. CONTROLS AND INDICATORS (cont)

CONTROLS OR INDICATORS	FUNCTION
FILM DRIVE CHANNEL	Selects which channel is operational in the manual and automatic mode.
X - Y - AZ switch	This is the AUTO-MAN mode switch. In the MAN position, manual operation of the three drives can be effected. A holding coil holds the switch in MAN position. When TAPE READIN is depressed, the holding coil releases, and the switch goes into the AUTO position.
AZ POSITION indicator	Lights at three different positions of the azimuth drive: the ZERO position, the starting point for all servo runs, and the two LOAD positions when either the supply or takeup spools present themselves at the front loading doors. The indicator light gives only the approximate position for ZERO; the precise positioning is made with respect to the fiducial marks.
MISCELLANEOUS	
CYCLE COUNTER	Counts each time the platens extend and is located at the rear of the unit near the data master carriage.
AEC READ - 10X VIEWER	The positioning lever on the 10X viewer assembly can be placed in either of two positions. In the 10X VIEWER position the viewing screen is in operation. In the AEC READ position the light sensor for the 10X mode is placed in the light path.

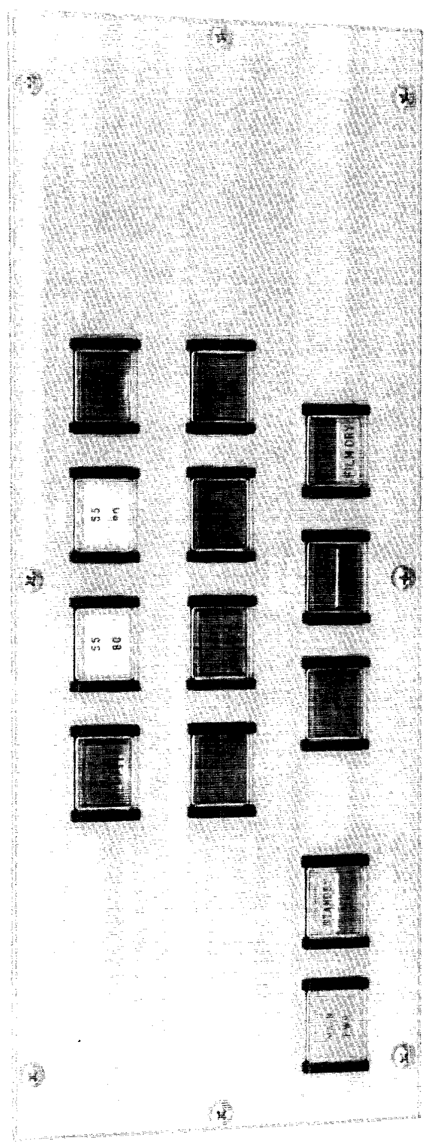

Figure 2-7. Upper Left Front Panel

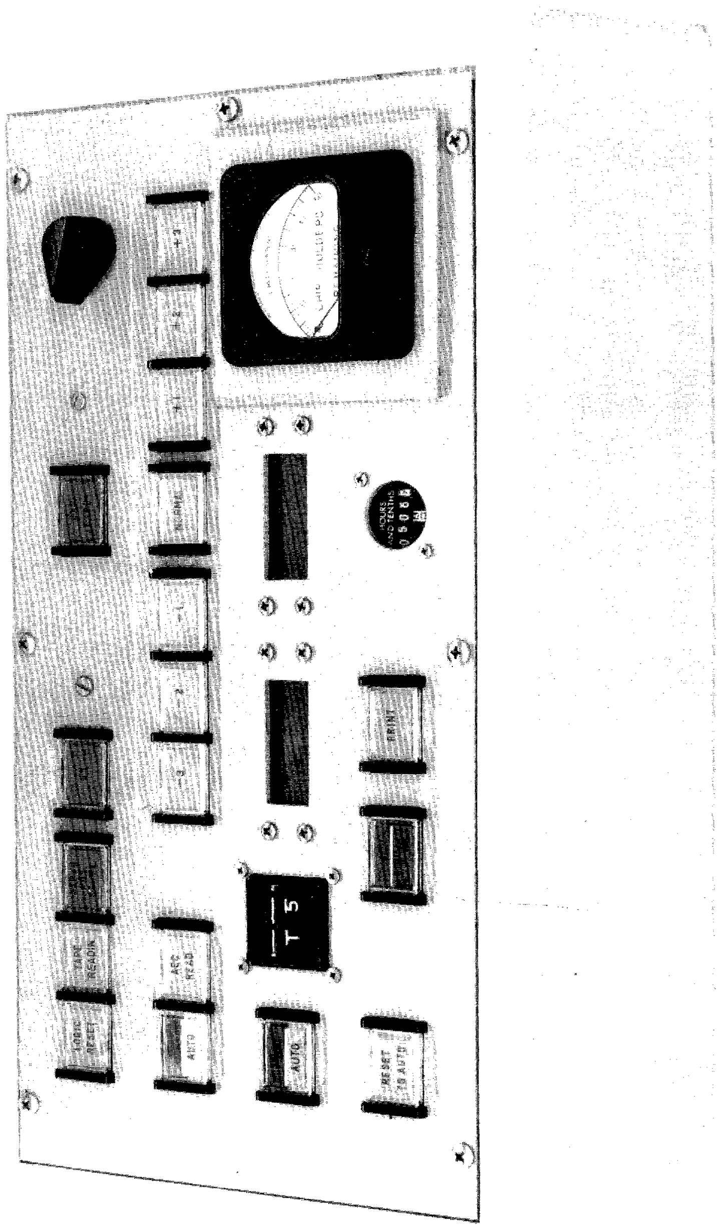

Figure 2-8. Lower Left Front Panel

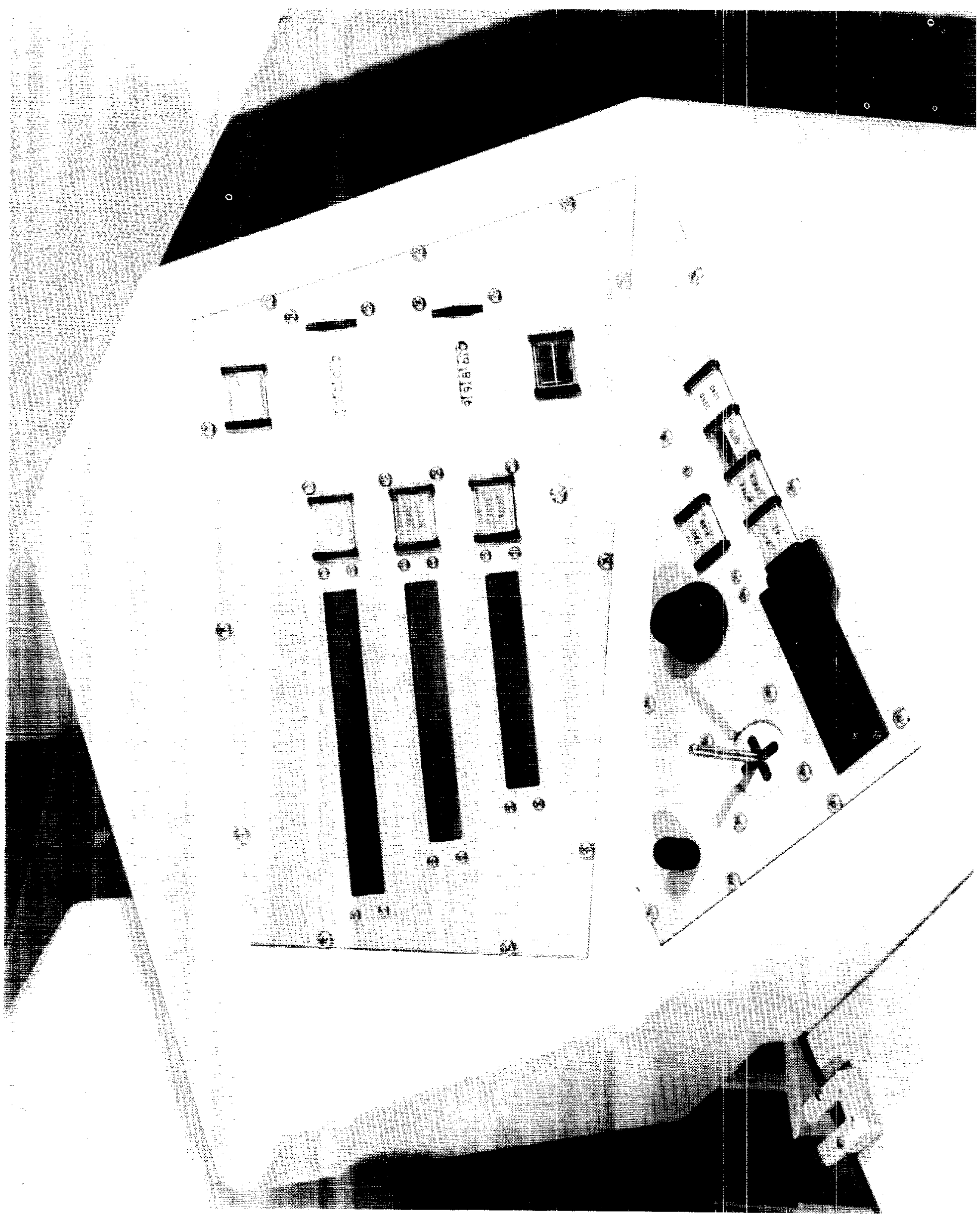

Figure 2-3. Upper Right and Lower Right Front Panels

2-21. TARGET FILM INITIAL POSITIONING. When a mask and a roll of target film have been properly installed in the unit, target film initial positioning can proceed. Depress LOGIC RESET momentarily. Depress X-Y-AZ to MAN. Depress MANUAL SELECT to AZ. Depress the operation switch and rotate the azimuth either cw or ccw until the AZ POSITION-ZERO lights. Depress MANUAL SELECT to X-Y. Using the operation switch and joystick, slew the proper film frame into view and align the film fiducial markers with the mask fiducial markers. If the film creeps in the X direction when the operation switch is released, adjust the BIAS TRIM until it stops.

2-22. TARGET FILM SERVOING. Manually position the target film as in paragraph 2-21. Place a punch tape in the teletype tape reader by placing the teletype mode switch to OFF, pressing the tape lid release button, inserting a tape between the tape guides, and then closing the lid. Turn the mode switch to LOC. At the Chip Format Printer, depress LOGIC RESET, depress the X, Y and AZ mensuration counter ZERO RESET switches. All three counters should read zero. Depress TAPE READIN. When the entire tape has been read in, the servos will start to move in sequence: first Y, then azimuth, and finally X. If the film oscillates slightly in the X direction, the BIAS TRIM may be used to stop it. When all three servos have come to their final position, the SERVO COMPL indicator will light.

2-23. OPERATOR MANUAL OPTIONS.

2-24. FILM TYPE. This selector switch must be placed at a position corresponding to the type of chip film being used.

2-25. EXPOSURE CONTROL. It it is found by previous experience with the Chip Format Printer that the normal automatic exposure control does not give satisfactory exposures on a particular frame, one of the seven EXPOSURE CONTROL switches may be depressed. The +1 switch increases the normal exposure by one stop, the +2 switch increases the normal exposure by two stops, etc. The -1 switch decreases the exposure by one stop, etc. The proper EXPOSURE CONTROL switch must be set before printing.

2-26. 10X VIEW. After the data master has been completely printed and the GO indicator lights, the operator can decide to use the 10X VIEW AEC rather than the auto AEC. The AEC VIEW switch must be depressed to 10X. After placing the positioning lever on the 10X viewer assembly in 10X VIEWER position and turning on the view lamps, the magnified film image [illegible] be seen on the viewing screen. After the proper point has been selected, leave the print [illegible] in that position. Place the positioning lever in the AEC READ position, shut off the [illegible], and then depress the 10X VIEW switch to AEC READ. The Xenon exposure lamp [illegible] come on and the AEC reading will be stored in the servo. After six seconds, the Xenon [illegible] lamp will extinguish and the print magazine may be moved to the print position. [illegible] can now take place by simply depressing the PRINT switch. If there is a change of [illegible] and it is desired to go back to the auto AEC mode, depress AEC & PRINTS REQD to [illegible] AUTO. This may be done even after the 10X VIEW AEC reading has been taken [illegible] must be done before printing.

[illegible] PRINTS REQUIRED. If for any reason the digital punch tape does not supply the unit [illegible] proper information on print quantity, this information can be put in manually. Depress [illegible] PRINTS REQD switch to MAN and set in the print quantity with NO PRINTS MANUAL [illegible] switch. The PRINTS REQD readout should reflect the same number as on the [illegible] switch. If it is desired to go back to the auto mode, depress AEC & PRINTS [illegible] RESET TO AUTO.

[illegible] PRINTING.

[illegible] There are several conditions that must be fulfilled before printing can proceed. The [illegible] should be properly positioned and the SERVO COMPL indicator must be on. The NO [illegible] must be off and the GO indicator must be on. This implies that the data master [illegible] completely printed and the data master carriage has returned to the data recording [illegible]. The number of chip holders in the chip holder supply must equal or exceed the [illegible] in the PRINTS REQD readout. There must be room in the development magazine [illegible] all of the prints. In fact, it would be preferable to always use an empty development [illegible], since this would preclude the possibility of error. The print magazine must be in [illegible] printing position corresponding to the mask size used. All access covers and doors must [illegible] prevent light leaks and the VIEW LAMP switch must be off. With everything [illegible] of readiness, remove the light trap from the chip cassette and gently lower the [illegible] inner chip container lifting knob by pulling out the side locking knob. (See [illegible] and 2-4.) Depress the PRINT switch.

2-30. COMPLETION OF OPERATION.

2-31. When the PRINT switch light goes out, printing is complete. Before removing the development magazine, release the chip cassette locking knob and pull the lifting knob all the way up. Insert the light trap into the chip cassette. This must be done because removing the development magazine will allow fogging of the chips in the cassette.

2-32. Before the target film is rewound, the liquid gate must be dried on the under side. This is accomplished by depressing the FILM DRY switch and allowing the air to flow until drying is complete. Depress LOGIC RESET momentarily, depress X-Y-AZ to MAN, and rewind the film back onto the supply spool. Depress STANDBY-ON switch to STANDBY and MAIN PWR switch to off. At the rear of the electronics console, shut off the air supply.

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SECTION III

THEORY OF OPERATION

3-1. PRINT MAGAZINE.

3-2. The theory of operation for the print magazine is divided into a discussion of the turret assembly (paragraphs 3-3 through 3-26) and the auxiliary vacuum and air systems (paragraphs 3-25 through 3-41). Figure 3-1 presents an overall view of the print magazine sequence.

3-3. AEC. The AEC has two modes of operation: AUTO and 10X. In the AUTO mode, the main light sensor is automatically positioned to the center of the format area, and a light reading is taken and stored by the AEC servo. The light sensor for this mode is affixed to the underside of the dark slide doors. This sensor consists of two Amperex RPY20 cadmium sulphide photoconductive cells connected in parallel. In the 10X mode, the light sensor is affixed to the 10X viewer assembly and can be positioned at any point along the center line of the format area in the fore-aft direction by moving the print magazine. The 10X mode sensor consists of a single Amperex RPY14 cadmium sulphide photoconductive cell. In the AUTO mode, the light sample is approximately a 1-inch square area, while in the 10X mode the light sample is approximately a 0.25-inch diameter circle.

3-4. AUTO - 10X Mode Switching (figure 3-2).

3-5. In the AUTO mode, all that is required is to place the print magazine into the print position and depress PRINT switch 1A1A4S16. To operate in the 10X mode, AEC VIEW switch should be depressed so that the 10X position of the switch illuminates. This energizes auto-10X relay 1A3A5K2 (located in the AEC servo drawer of the electronics console), which switches out the main light cell and switches the 10X light cell into the servo loop. In addition, AEC read relay 1A3A5K1 energizing line is switched from the auto loop to 10X VIEW switch 1A1A4S12. When 10X VIEW switch 1A1A4S12 is depressed so that the AEC READ position of the switch is illuminated, AEC read relay 1A3A5K1 is energized, which turns on the print lamp and the AEC servo. This switch also energizes six-second time delay relay

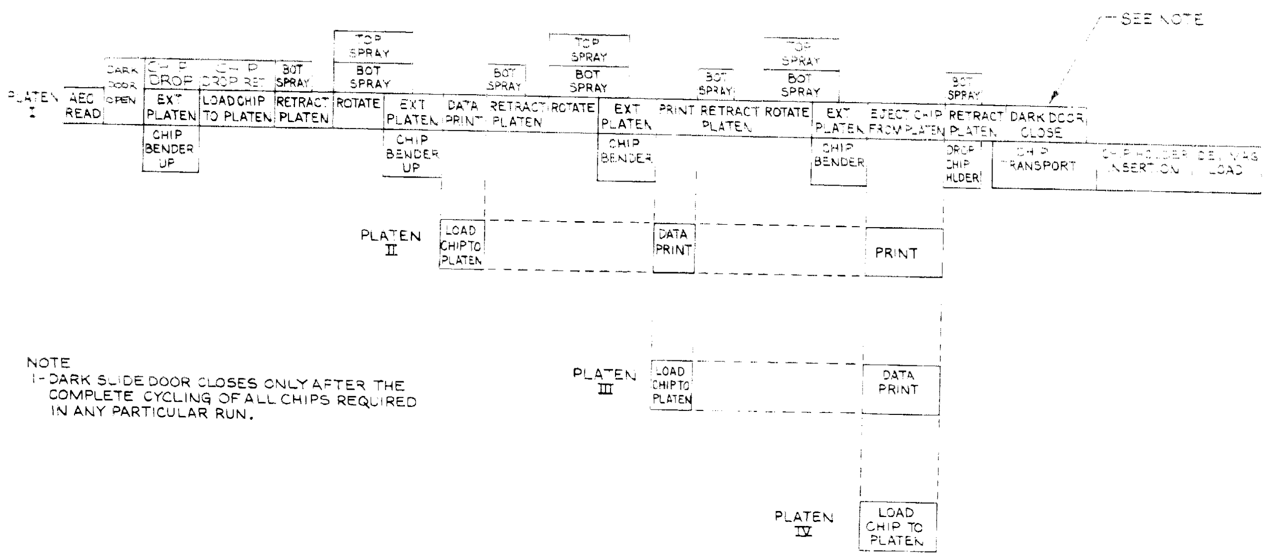

Figure 3-1. Print Magazine Sequence

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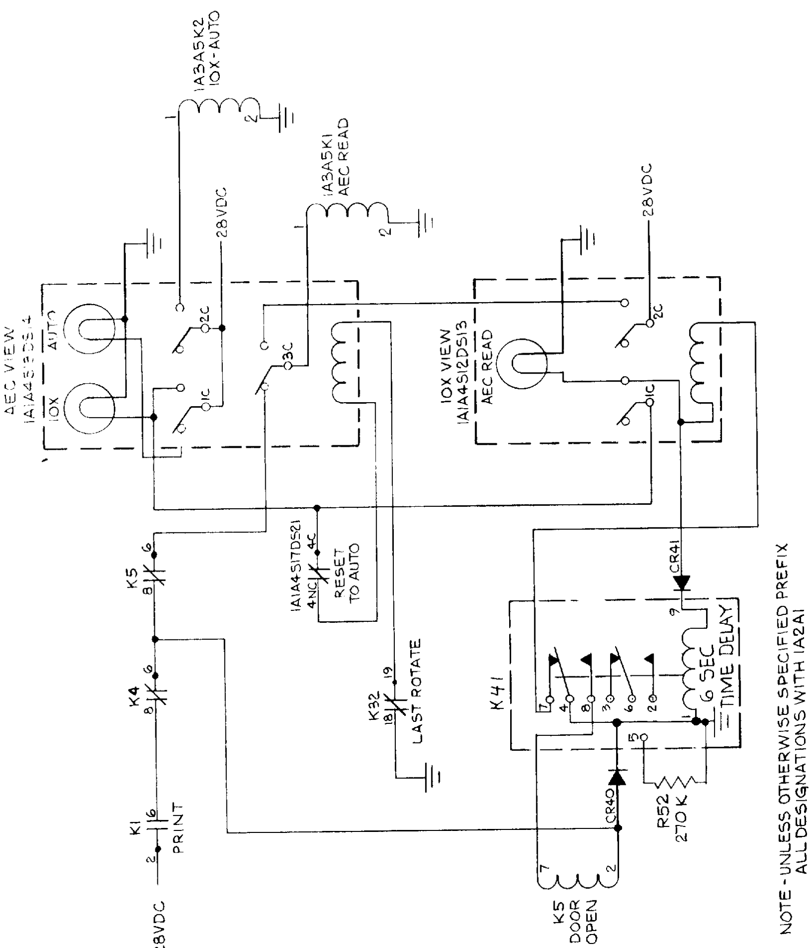


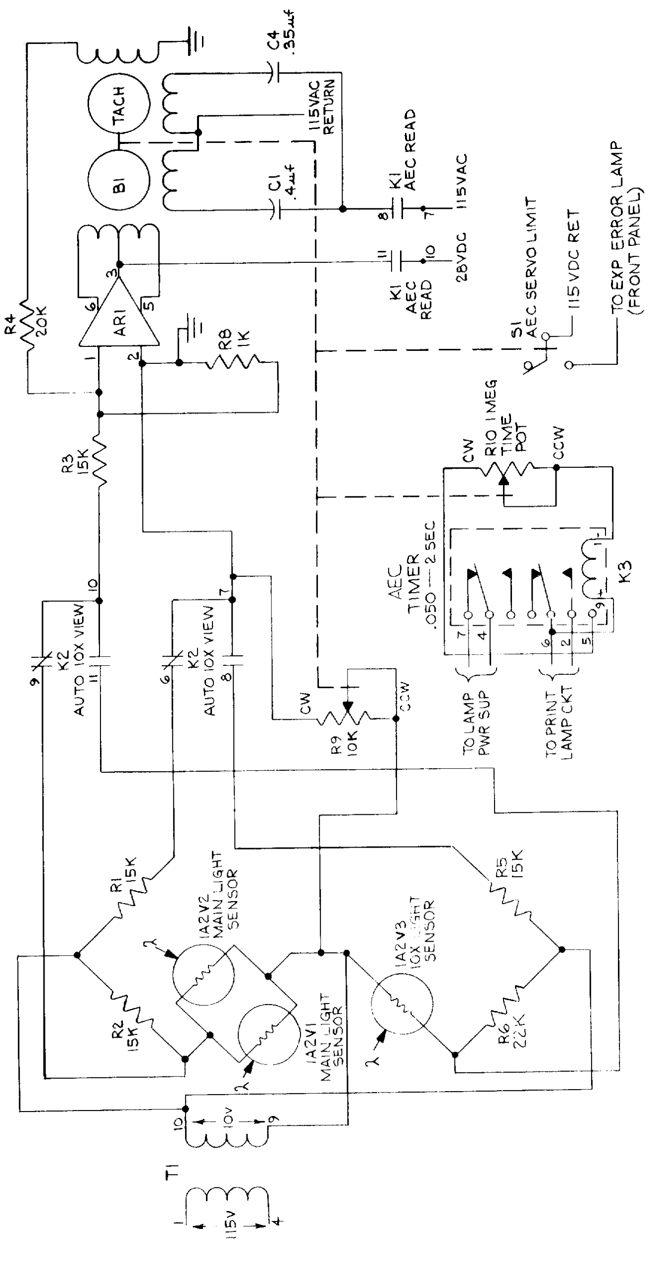
Figure 3-2. AEC AUTO-10X Switching

1A2A1K41. After six seconds, relay K41 closes, removing the ground from the holding coil of 10X VIEW switch 1A1A4S12, which in turn, deenergizes AEC read relay 1A3A5K1. This shuts off the exposure lamp and deenergizes the AEC servo. Relay K5 does not function in the circuit at this time. At the end of a run, last-rotate relay 1A2A1K32 energizes opening contacts 19 and 18, which releases the holding coil of AEC VIEW switch 1A1A4S13, thereby, readying the circuits for another run (with the choice of the AUTO or 10X mode). (A run is considered any number of duplicate exposures of the same target.)

3-6. AEC Servo (figure 3-3).

3-7. The AEC servo consists of a size 11 motor-tach combination, geared to a 10K feedback potentiometer and a 1 meg° time potentiometer, which sets exposure time on electronic timer relay 1A3A5K3. In addition, there is a limit switch which illuminates the EXP ERROR lamp (front panel), whenever the range of the AEC servo is exceeded. In the AUTO mode auto-10X relay 1A3A5K2 is deenergized, connecting R9 feedback potentiometer into the bridge with the main light cells 1A2V1 and 1A2V2. The bridge excitation is 10 volts, 60 Hz, using step-down transformer T1. When a light reading is called for, AEC read relay K1 energizes connecting +28 vdc and 115 volts, 60 Hz to the servo motor and amplifier. Feedback potentiometer R9 balances the bridge, and the servo comes to rest. The time potentiometer is now properly positioned to set electronic timer relay 1A3A5K3 for the exposure level read by the light cells. After six seconds (determined by six-second time delay relay 1A2A1K41), AEC read relay K1 deenergizes, removing the ac and dc voltage from the servo motor and amplifier. Time potentiometer R10 remains in the same position throughout the run. The servo is not energized again until the next AEC reading is called for at the start of a new run. In the 10X mode, auto-10X relay K2 is energized and feedback potentiometer R9 is switched into the lower bridge containing the 10X light cell 1A2V3. The operation and results are the same as above.

3-8. DARK SLIDE DOORS (figure 3-4). Before power is applied to the system, it must be made certain that the dark slide doors are closed, otherwise the platens will start to extend at the same time the doors start to close and a jam is most likely to occur. When +28 vdc is applied to latching relay K1 through C4, relay K1 is pulsed down in the direction of the arrow. Capacitor C4 takes approximately 5 milliseconds to fully charge, and thereafter, has no



NOTE - UNLESS OTHERWISE SPECIFIED PREFIX ALL DESIGNATIONS WITH 1A3A5

Figure 3-3. AEC

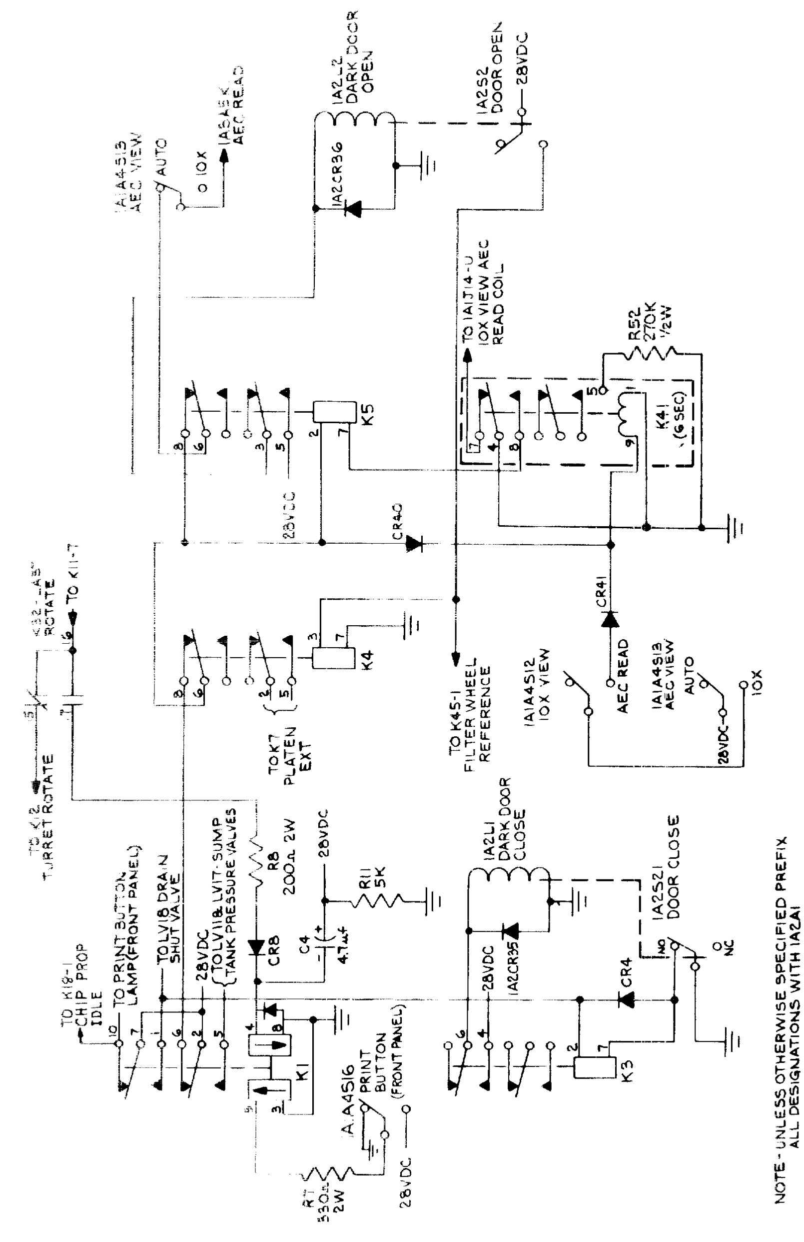


Figure 3-4. Dark Slide Door and Print Start

effect on the operation of relay K1. When +28 vdc is removed, capacitor C4 discharges through resistor R11 and is ready for the next power turn on. With +28 vdc applied through pin 1 of relay K1, relay K3 is energized and in sequence energizes door-close solenoid 1A2L1. When the doors are fully closed, door-close switch 1A2S21 actuates, deenergizing relay K3, which deenergizes door-close solenoid 1A2L1. If the doors were accidently or forcibly opened, door-close switch 1A2S21 would actuate, energizing door-close solenoid 1A2L1, and the doors would close again. The doors always remain where they are placed until they are energized into a new position. When depressing PRINT switch 1A1A4S16, latching relay K1 is energized, in the up direction, removing power from the dark door-close circuit and allowing the doors to be opened at the proper time. K1-6 now applies +28 vdc through the normally closed contacts of relays K4 and K5 to energize AEC read relay 1A3A5K1 when in the AEC VIEW-AUTO mode. This turns on the PRINT lamp, operates the AEC servo, and starts the recording of the AEC reading. In addition, +28 vdc is applied to pin 2 of relay K5, but relay K5 does not energize until the ground connection is made through six-second time delay relay K41. Power is also applied to pin 6 of relay K4, starting the 6-second timing. After six seconds, relay K41 energizes, making ground contact through pin 7 of relay K5. Relay K5 energizes door-open solenoid 1A2L2. When the doors are fully open, door-open switch 1A2S2 actuates energizing relay K4. With relay K4 energized, power is removed from relay K5 and, ultimately, door-open solenoid 1A2L2. Door-open switch 1A2S2 is actuated by the doors themselves and not the solenoid. Therefore, switch 1A2S2 remains actuated, keeping relay K4 energized. Relay K41 is also deenergized, and it resets itself. At the end of a run, last-rotate relay K32 energizes, and at the appropriate time (when the platens are completely retracted and not rotating), +28 vdc is applied through diode CR8 to pin 4 of relay K1, energizing it in the down position. Power is removed from the door-open circuit and is applied to the door-close circuit (relay K3 and solenoid 1A2L1). The doors now close and the unit is ready for another run.

3-9. FILTER WHEEL (figure 3-5). The filter wheel is an eight-segment glass disk with pie-shaped Inconel neutral density filters affixed to it. It is located in the Xenon print lamp housing and is used to attenuate the printing light (depending on the type of film used as the output material). The densities of the filter wheel segments are 0 to ND 2.1 in ND 0.3 steps as indicated in figure 3-5. The filter wheel is driven by a Ledex digimotor, which is a

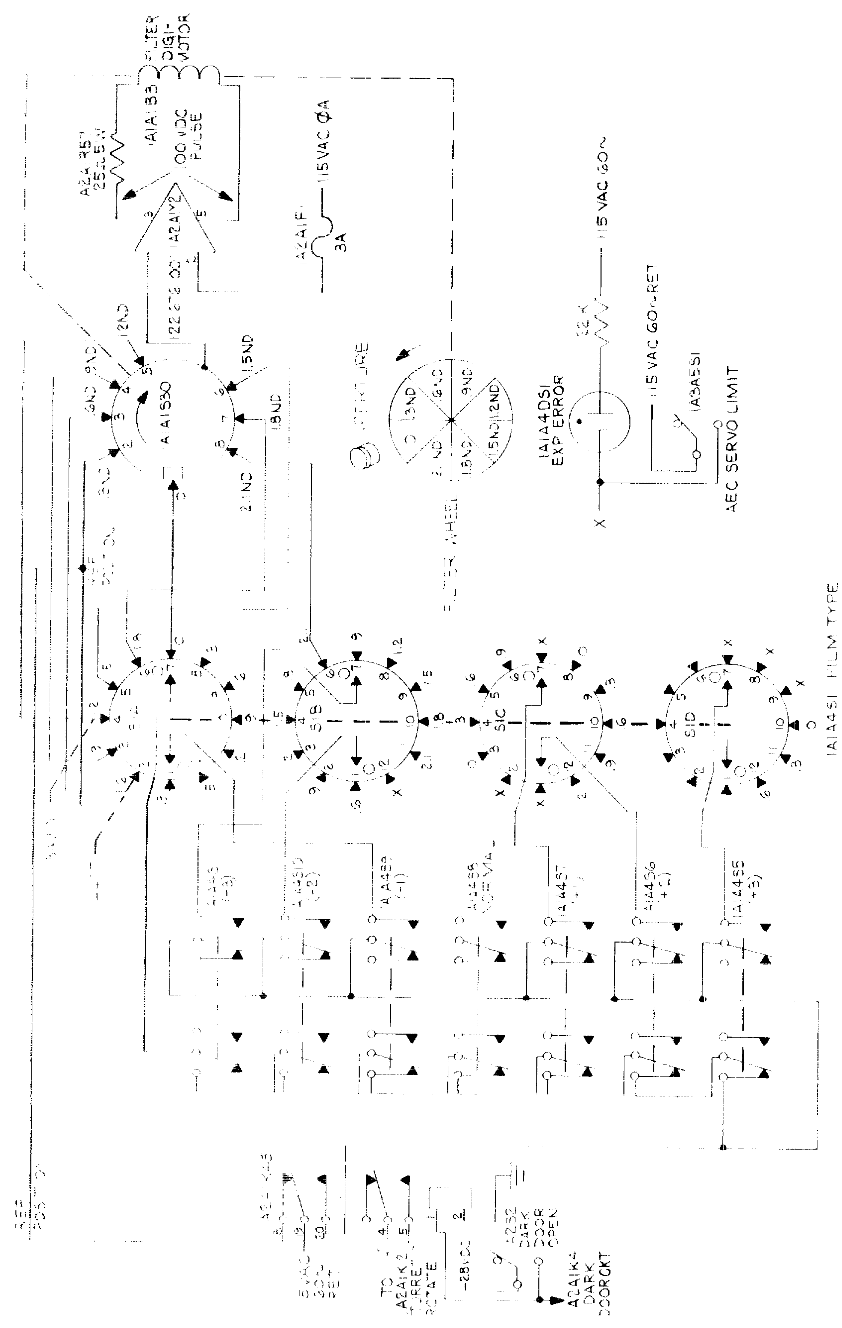


Figure 3-5. Filter Wheel Positioning

simple type of stepping motor. The digimotor is driven by a solid state pulser with 100 vdc output pulses, through an internal SCR type circuit. The controlling element is a notch homing-type wafer switch (1A1A1S30), which is pictured in figure 3-5. When the notch on the wafer switch comes to the clip which is completing the circuit, power is removed from pulser 1A2A1Y2, causing the digimotor to stop. The digimotor is held in position by a detent.

NOTE

> In figure 3-5, all numbers such as .3, .6, .9, etc. (located on switches 1A1A4S1 and 1A1A1S30) refer to filter wheel neutral density positions, and all similarly numbered contacts are electrically connected. Also, all contacts marked X are connected together and go to EXP ERROR lamp 1A1A4DS1. Switches 1A1A4S5 through 1A1A4S11 are holding coil switches connected through a bailing circuit (not shown) so that only one switch remains actuated at any one time.

3-10. When the AEC reading is taken, the filter wheel is always in the same position regardless of the film setting on the front panel. This position is called the reference position and occurs automatically without requiring operator attention. When power is first applied to the unit, the dark slide doors are closed, so door-open switch 1A2S2 is open and relay K45 is deenergized. The ground return for the digimotor pulser is through the normally closed contacts of relay K45-18 to the reference position, ND .3. The pulser will have an output until the digimotor steps switch 1A1A1S30 to ND .3 position. The power is then removed from pulser 1A2A1Y2, which causes the digimotor to stop. When PRINT transilluminated switch 1A1A4S16 is depressed, door-open switch 1A2S2 is closed, and relay K45 energizes. FILM TYPE switch 1A1A4S1 and its associated seven switches 1A1A4S5 through 1A1A4S11 control the position of the filter wheel. Switches 1A1A4S5 through 1A1A4S11 are shown in their normally open positions, and switch 1A1A4S1 is shown in the extreme cw position. NORMAL switch 1A1A4S8 does not have a holding coil, so it always returns to the position shown after it is depressed and released. The other switches remain in the actuated position when they are depressed until another switch is depressed. That switch will then release due to the bailing circuit. When relay K45 energizes, the 60 Hz return is applied through relay K45-20 and the left-side contacts of switches 1A1A4S5 through 1A1A4S11 to a 0 position of switch 1A1A4S1. The filter wheel was previously in its reference position ND .3.

Power is therefore applied to the pulser, and the digimotor steps around until the notch of switch 1A1A1S30 reaches the 0 position. The digimotor now stops. A similar sequence will occur for any other position of FILM TYPE switch 1A1A4S1 or transilluminated switches 1A1A4S5 through 1A1A4S11. However, if these switches are positioned so that the 60 Hz return is applied to any contact marked X, the filter wheel will not move, but retain its last position. In addition, EXP ERROR lamp 1A1A40S1 also illuminates after the dark slide doors open. This indicates that the filter wheel cannot move the number of stops called for (usually by the seven switches 1A1A4S5 through 1A1A4S11) without going into the region of incorrect density. For example, if the filter wheel is in the 0 position as shown, and it is required to move one stop less dense, +1 switch 1A1A4S7 should be depressed. Pressing this switch, will connect the 60 Hz return on the contact marked X. EXP ERROR lamp 1A1A40S1 will illuminate because the filter wheel cannot set to a position less dense than 0 ND. A similar situation will happen for any other like occurrance.

3-11. CHIP DROP (figure 3-6). The chip dropper consists of two 20 oz-in. dc torque motors, each driving a shaft on which is mounted three rubber rollers. Each shaft rotates independently. In order to drop a chip, one set of rollers, called the No. 1 rollers, rotates approximately 300 degrees towards the center of the chip drop assembly. This drives one end of the chip out of the chip cassette. The No. 1 rollers now rotate back to the start or return position. When the No. 1 rollers come back to the return position, the No. 2 rollers start to rotate towards the center of the chip drop assembly, driving the other end of the chip out of the chip cassette and onto the platen. The No. 2 rollers now come back to the return position, and the chip drop is complete.

3-12. Electrically, the chip drop is accomplished as follows. When power is turned on in the unit, the rollers will drive until both sets are in the return position. This means that K60 and K61 are both energized down, and S34 No. 1 retract switch is actuated. K18 is de-energized so that R89 and R90 are in the current path to their respective motors so that the motors are not unduly heated while the unit is just idling. With these resistors in the circuit, there is still sufficient torque so that the rollers can return to the return position even if they are disturbed. When the PRINT switch (front panel) is pressed, K1 closes and K18 is energized, shorting out R89 and R90. When the platens extend fully, 1A2S4 platen extend switch is actuated, energizing K10. K10-4 applies 28 vdc to K60-9 through C25, pulsing K60

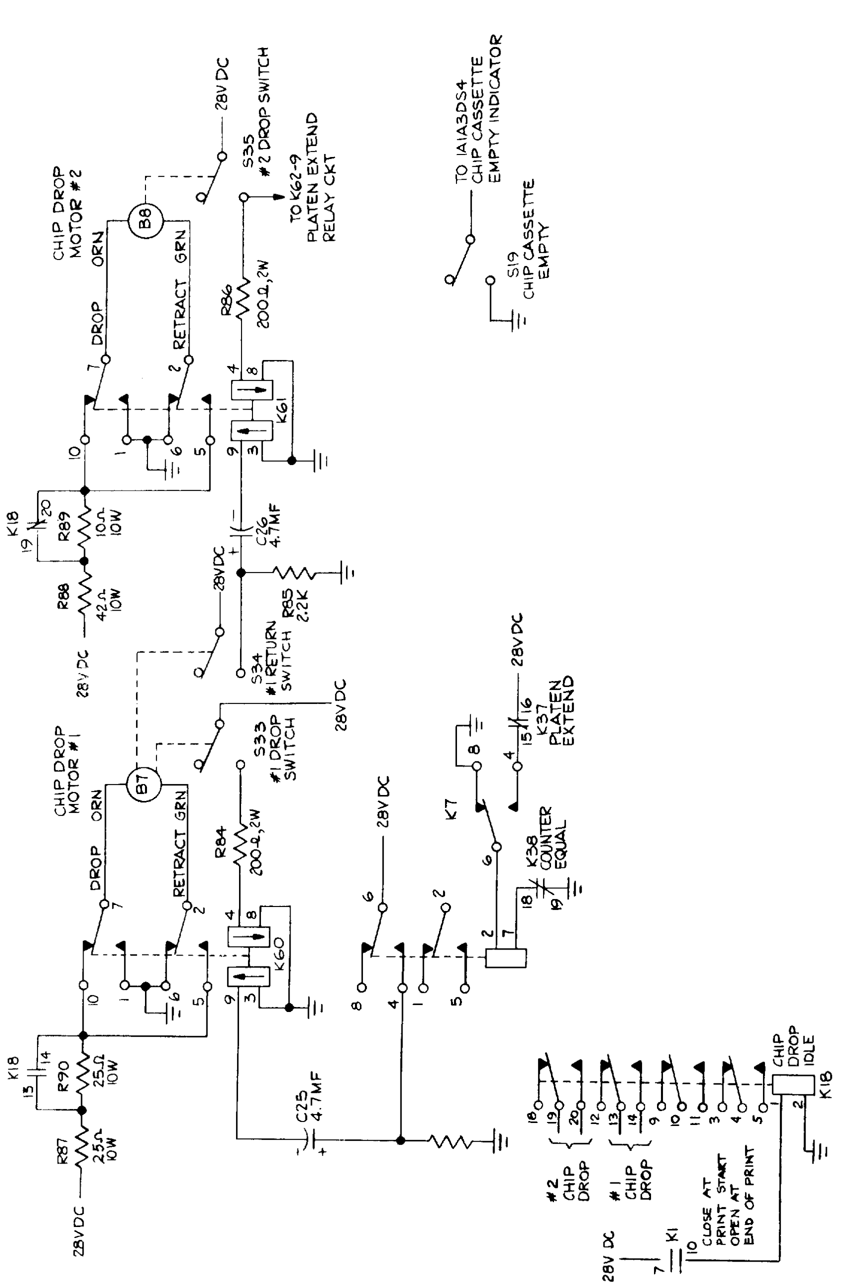


Figure 3-6. Chip Drop

up. No. 1 chip drop motor B7 now drives in the drop direction and the No. 1 rollers drive one side of the chip out of the chip cassette. When the motor comes to the end of its rotation, S33 No. 1 drop switch is actuated, pulsing K60 down. With K60 in this position, excitation to B7 is reversed, and now the rollers are driven back to the return position. At return, S34 No. 1 return switch is actuated, pulsing K61 down through C26. No. 2 chip drop motor B8 now drives in the drop direction, driving the other end of the chip out of the chip cassette. The chip falls onto the waiting platen. At the end of the drop sequence, S35 No. 2 drop switch is actuated, energizing K61 down. The excitation to B8 is reversed, and the No. 2 chip drop motor and rollers return to the return position. A similar sequence occurs each time the platens extend until the proper number of chips have been dropped. At that time counter equal relay K38 is energized, opening up contacts 18 and 19. K10 can no longer be energized and no more chips are dropped.

3-13. PLATEN EXTENSION AND RETRACT (figures 3-7 through 3-9 and 3-20). Two conditions must be satisfied before relay K7 will energize. The turret must be in a 90-degree position (any one of four positions), and the dark doors must be open. When these conditions are fulfilled, the respective relays will energize, completing the ground leg for relay K7. At the initial application of +28 vdc to the unit, turret 3/4 rotate switch 1A2S12 pulses relay K8 through capacitor C2. The turret will normally be in a 90-degree position, so that as soon as the dark doors open, relay K7 will energize through relay K8-10. Plus 28 vdc is now applied to motor 1A2B1 through the path of relays K37-15 and 16 and K7-4 and 6, platen 3/4 extend switch 1A2S18 No. 1 and 2, and relay K6-10 and 7. When the platens have extended 3/4 of their full stroke, platen 3/4 extend switch 1A2S18 deactivates, and resistor R5 is placed in series with the motor, slowing it down. Just prior to being fully extended, platen 3/4 extend switch 1A2S18 closes again, shorting out resistor R5 and putting full power on the motor so that maximum pressure is applied to chip and target film during exposure. When the platens are fully extended, switch 1A2S4 (figure 3-8) actuates. After a chip has been dropped on the platen as signified by the closing of the contacts of K62, which is actuated by S35, No. 2 chip drop switch actuates and after a delay of about 200 milliseconds (provided by resistor R49, capacitor C20, and transistor Q10) platen extend relay K37 energizes. The energizing of relay K37 (figure 3-7) breaks the +28 vdc path to motor 1A2B1. (Even though power is removed from the motor, the platens cannot be forcibly retracted at this time due

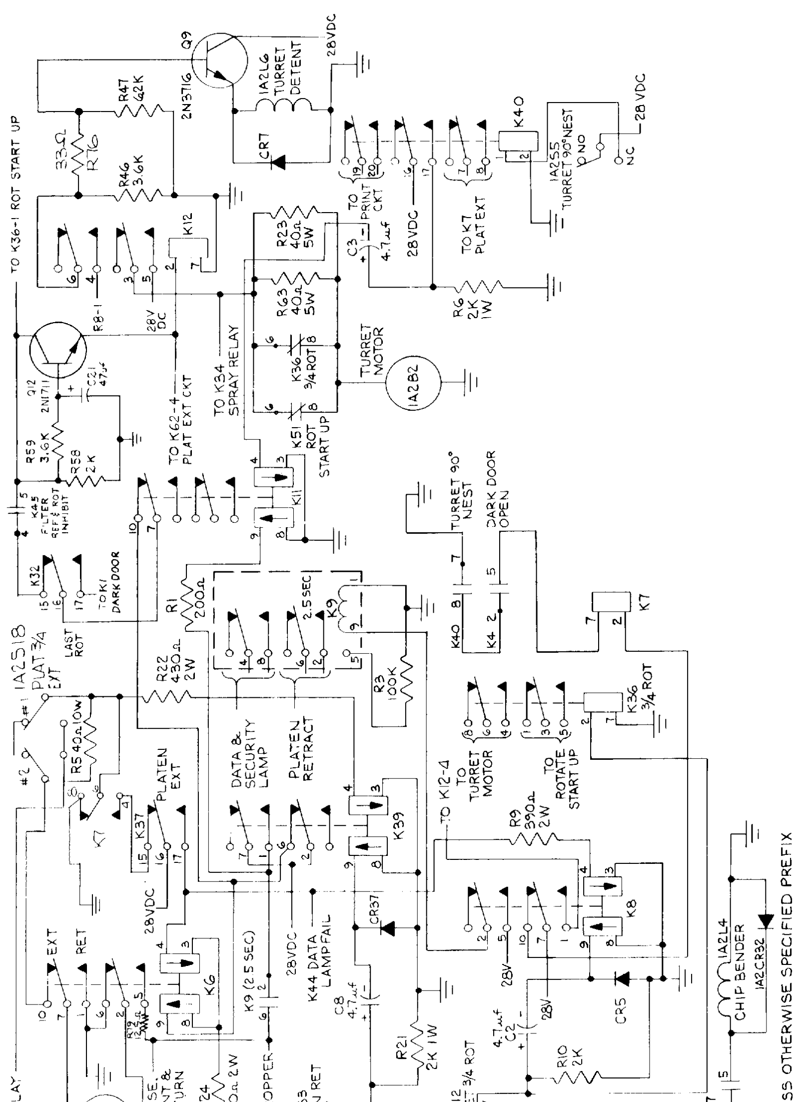


Figure 3-7. Platen-Turret Circuitry

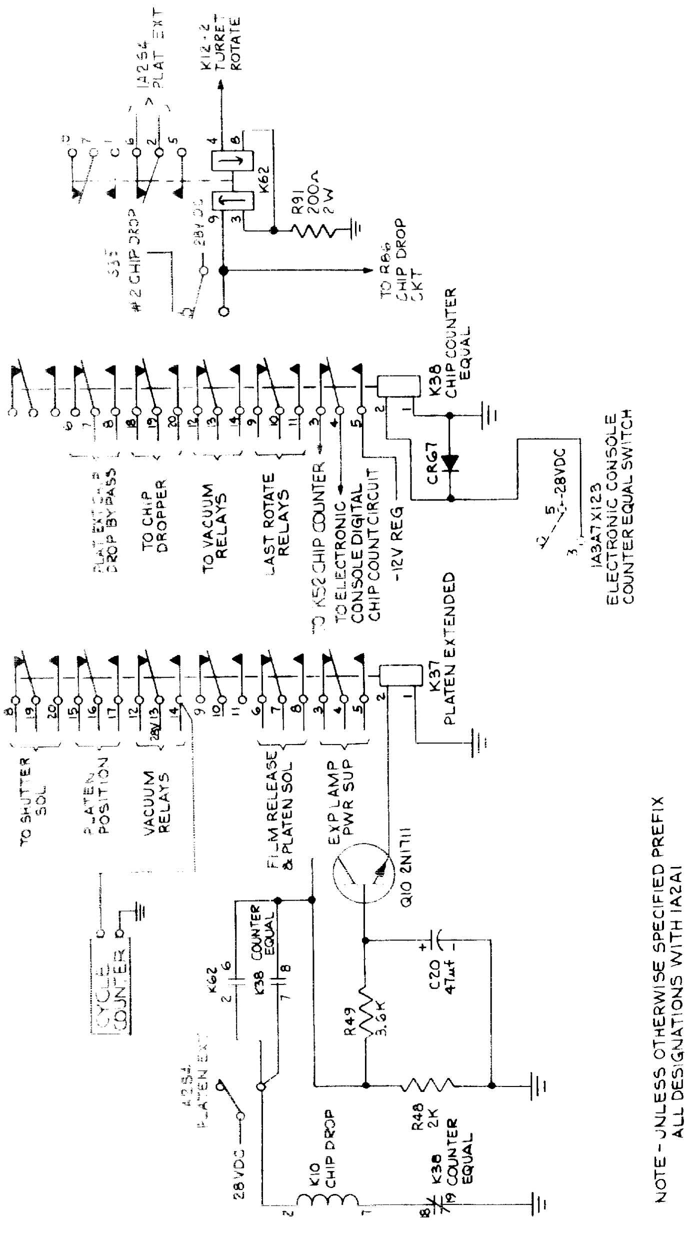


Figure 3-8. Platen Extended and Counter Equal Relays

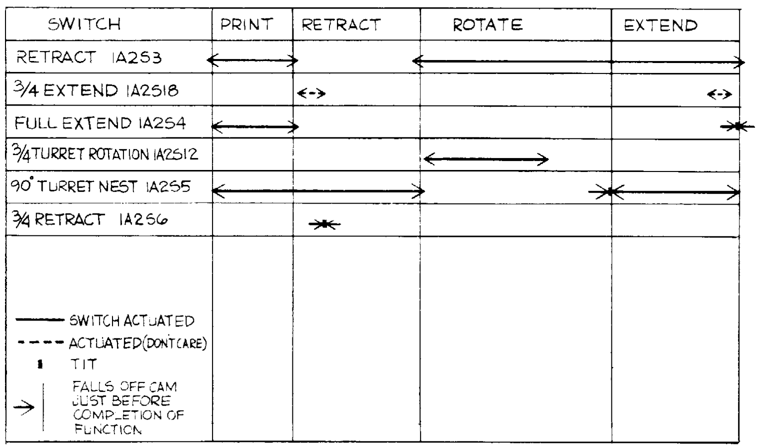


Figure 3-9. Platen-Turret Switches

to the action of the one-way clutch which is held in place by the platen detent solenoid.) Relay K6-4 is energized in the down position by relay K37-16 and 17. In addition, relay K8-4 is also energized in the down position by the same contacts of relay K37, so that relay K7 becomes deenergized. With relay K8 energized in the down position 2.5-second delay relay K9 starts timing. After 2.5 seconds relay K9 energizes and +28 vdc is applied to platen motor 1A2B1 in the retract direction by relays K39-7 and 1, K9-2 and 6, and K6-5 and 2. In addition, K35 is energized by K39-7 and 1, K9-2 and 6, and K37-7 and 8 (figure 3-20). K35 applies +28 vdc to platen detent solenoid 1A2L3, releasing the one-way clutch and allowing the platens to retract. When the platens are fully retracted, platen retract switch 1A2S3 actuates, pulsing relay K39 to the down position through capacitor C8. Relay K39-6 energizes relay K6 in the up position, removing power from platen motor 1A2B1. Resetting for the next platen extension occurs when relay K7 energizes after the turret has rotated 90 degrees. Platen retract switch 1A2S3 is actuated by a cam, driven by a one-way clutch in the extend-retract gear train. This cam remains stationary during the platen extension and only rotates during the retract cycle. Therefore, platen retract switch 1A2S3 remains actuated during the platen extension, deactuated at start of the retract cycle, and actuated again at full retract.

3-14. CHIP COUNT (figure 3-10). Chip counting works in the same manner, whether in AUTO or MAN PRINTS REQD mode. The only difference is that in the AUTO mode, the number of chips to be printed is fed in by the tape and in the MAN PRINTS mode, the front panel thumbwheel switch sets the number. When chips are to be dropped, vacuum is switched to the platen at the chip drop station only at platen full extend. If a chip has been dropped and properly seated, the appropriate VAC switch (PS I, II, III, and IV for platens I, II, III and IV respectively) will close, indicating that a chip is on and properly seated. The VAC switch remains actuated until vacuum is removed from the platen at the eject station. Since the operation of all the platens are similar, only the operation of platen I will be described. When a chip is dropped on platen I, VAC switch I actuates, energizing VAC switch I relay K53. Since relay K27 is energized at this time (see figures 3-18 and 3-19), +28 vdc is applied to relay K52-3. Relay K52 energizes, supplying a count pulse through deenergized chip counter equal relay K38 to a one-shot multivibrator in the electronics console. When the chip counter is in the quiescent state, regulated -12 vdc is applied to the one-shot multivibrator through relays K52-4 and 2 and K38-3 and 4. The one-shot multivibrator triggers on

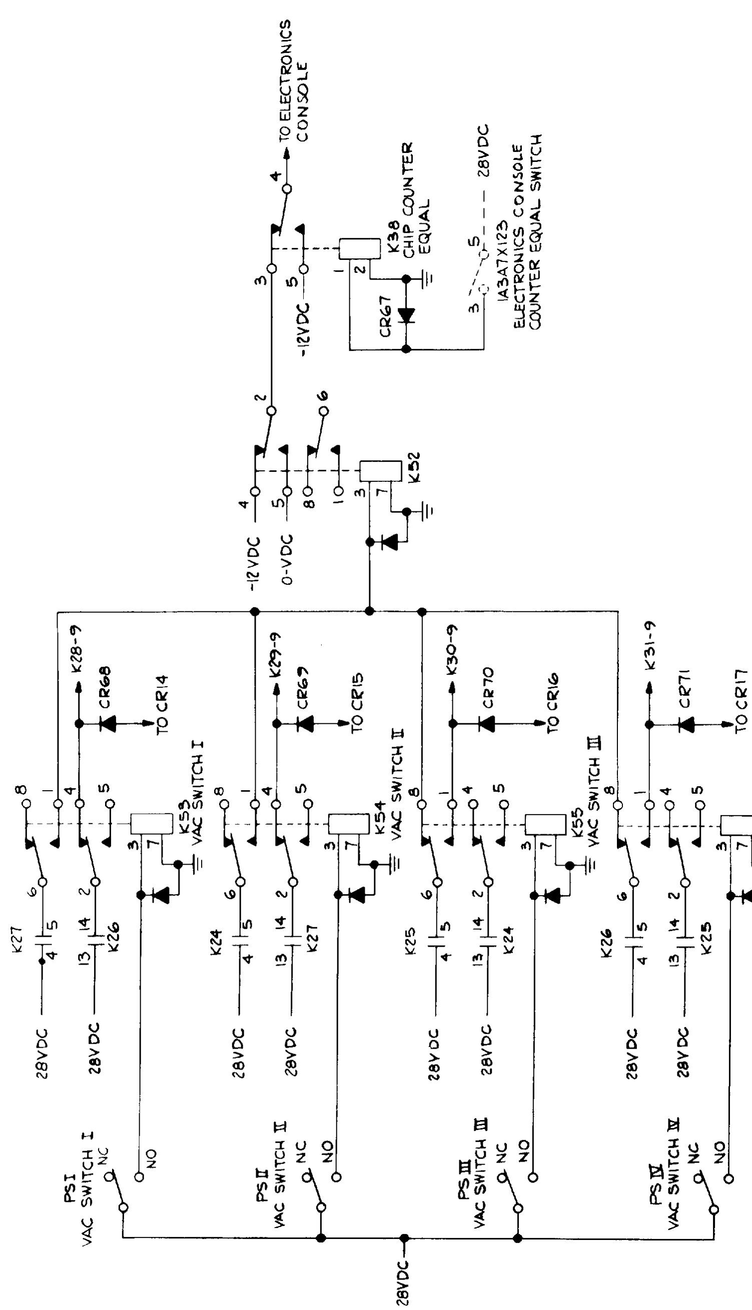


Figure 3-10. Vacuum Switches and Chip Counters

a positive going signal. When relay K52 energizes, pin 2 goes to 0 vdc, supplying the required positive going signal to the one-shot multivibrator. The one-shot multivibrator drives two decade counters, which feed the display drives, illuminating the PRINTS PRINTED indicator on the front panel. In addition, the decade counters feed an eight-bit comparator. When the number of prints printed equals the number of prints required, the comparator puts out a signal which energizes chip counter equal relay K38 (figure 3-8). With relay K38 energized, +12 vdc is continuously applied to pin 4, and no further chip counts can occur.

3-15. PLATEN ROTATION STARTUP (figure 3-11). A special rotation startup circuit is included because the rotating vacuum seals in the turret vacuum manifold set after prolonged idleness, and extra power is needed to rotate initially. After one rotation the seals go back to normal, and the rotation startup is not needed. When +28 vdc is first applied, turret 3/4 rotate relay K36 is energized through turret 3/4 rotate switch 1A2S12. Rotation startup relay K51 is therefore deenergized, and pins 6 and 8 short out dropping resistors R23 and R63 in the turret motor circuit, applying full power to the motor when it is called to rotate. At the proper time, turret-rotate relay K12 energizes and power is applied to turret motor 1A2B2. After a few degrees of rotation, turret 3/4 rotate switch 1A2S12 actuates, deenergizing relay K36. Since there is +28 vdc at relay K12-2 (remember the turret is still rotating, so relay K12 is energized), relay K51 will energize, removing the short across resistors R23 and R63 through relay K51-6 and 8. However, since relay K36 is now deenergized, these resistors will still be shorted through relay K36-6 and 8. Relay K51 latches by pin 2 and stays energized until last-rotate relay K32 energizes, releasing the latch and making ready for the next run.

3-16. NORMAL PLATEN ROTATION (figures 3-7 through 3-9). When the platens have extended and then fully retracted, relays K11 and K39 are energized in the up position (see table III). Turret-rotate relay K12 is energized by relays K39-6 and K11-7. With relay K12-6 energized, base current is applied to transistor Q9, energizing turret detent solenoid 1A2L6. The solenoid pulls in, releasing the turret rotation gear train. Turret motor 1A2B2 is energized by relay K12-3 either through resistors R23 and R63 or bypassed through 3/4 rotate relay K36-6 and 8, depending on the position of 3/4 rotate switch 1A2S12. When the turret has rotated a few degrees, 3/4 rotate switch 1A2S12 actuates, allowing capacitor C2 to discharge through diode CR5 and resistor R10. At approximately 3/4 of a rotation, switch

TABLE III. PLATEN-TURRET RELAY ACTUATION

	Turn on power	Start Extend	3/4 Extend	Full Extend	End 2.5 Sec	Start Retract	3/4 Retract	Full Retract	Start Rotate	3/4 Rotate	90° Nest	Start Extend
K7	dk dr ON open	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
K10	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	ON
K8	UP	UP	UP	DWN	DWN	DWN	DWN	DWN	DWN	UP	UP	UP
K6	UP	UP	UP	DWN	DWN	DWN	DWN	UP	UP	UP	UP	UP
K39	UP	DWN	DWN	DWN	DWN	DWN	DWN	UP	UP	UP	DWN	DWN
K11	DWN	UP	UP	UP	UP	UP	UP	UP	UP	UP	DWN-UP	UP
K12	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF

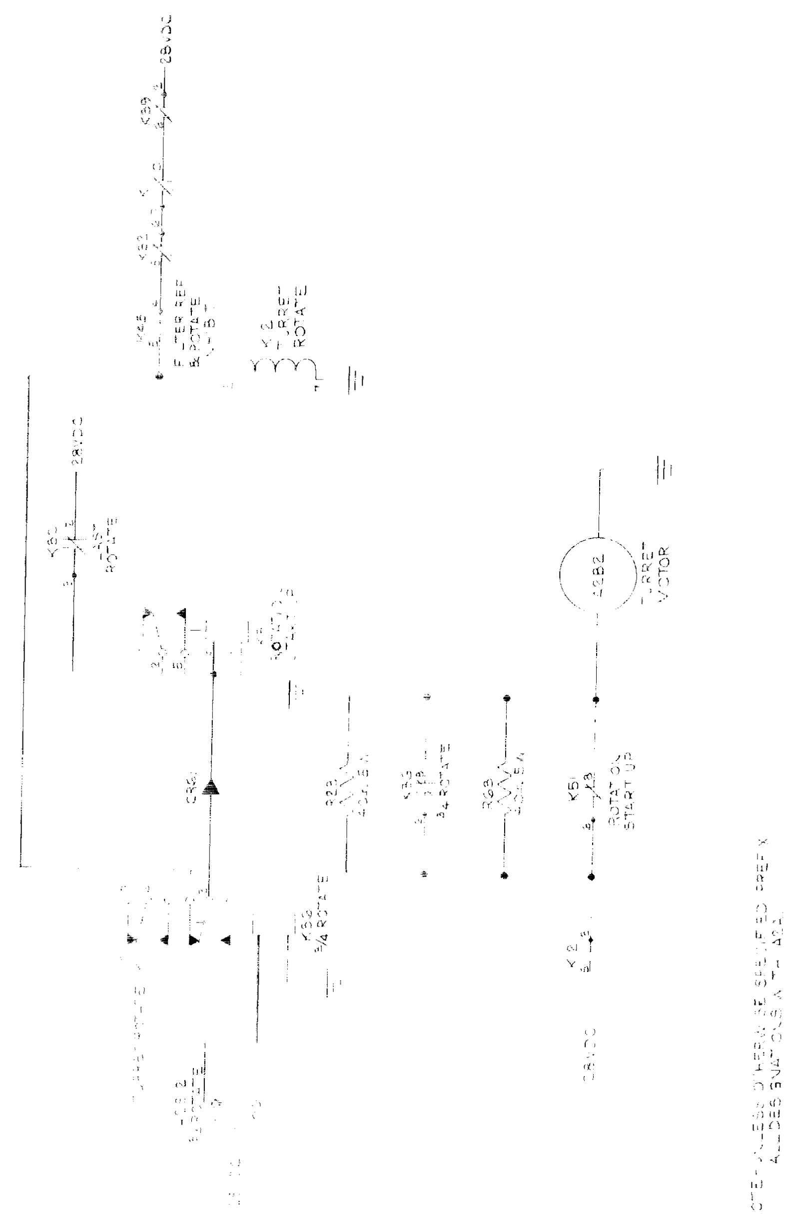


Figure 3-11. Rotation Startup

1A2S12 deactuates again, pulsing relay K8 up through capacitor C2. When relay K8 is energized in the up position, +28 vdc is removed from the base of transistor Q9, deenergizing turret detent solenoid 1A2L6. The solenoid pin now rides on the detent plate. When the turret has rotated 90 degrees, the detent (one of four) reaches the solenoid pin. The pin falls in the hole and the turret stops rotating. Simultaneously, Turret 90-degree nest switch 1A2S5 actuates, energizing 90-degree nest relay K40, which energizes relay K11 in the down position through relay K40-17. Relay K11 deenergizes turret-rotate relay K12 and power is removed from turret motor 1A2B2. This process is repeated for each subsequent rotation.

3-17. SECURITY CLASSIFICATION (figure 3-12). The unit is capable of producing ten different security classification messages. Security messages are written on each side of a ten-sided cylinder. There are eight small lamps wired in parallel inside the cylinder, which provide exposure illumination. The lamps remain fixed in position while the cylinder rotates about them to index each new message into exposure position. The security classification message is driven by a +28 vdc digimotor and pulser. The digimotor also drives a notch homing-type wafer switch, 1A2S26. The incoming tape information closes one of ten reed switches in the electronics console. These switches have schematic reference designations 1 through 10. With one reed switch actuated (only one at a time may be actuated), +28 vdc is applied to the wafer of switch 1A2S26, thereby energizing relay K46. Relay K46 applies power to pulser Y1 until the digimotor steps the security message and the wafer switch around until the notch of the switch falls on the energized clip. Power is now removed from relay K46, the pulser, and digimotor, and the security classification cylinder stops at the specified message.

3-18. SECURITY CLASSIFICATION AND DATA EXPOSURE (figure 3-13). When the platens are fully extended, platen extend relay K37 energizes, and 28 vdc is applied through the normally closed contacts of 2.5-second relay K9. Relay K44 now energizes, and the data and security classification lamps are illuminated. After 2.5 seconds, relay K9 deenergizes, deenergizing relay K44, and the illuminated lamps extinguish. The exposure time is always 2.5 seconds.

3-19. DATA LAMP FAIL (figure 3-13). The security classification exposure source consists of eight lamps in parallel. All latching relays used on this unit have 160-ohm, 12-volt

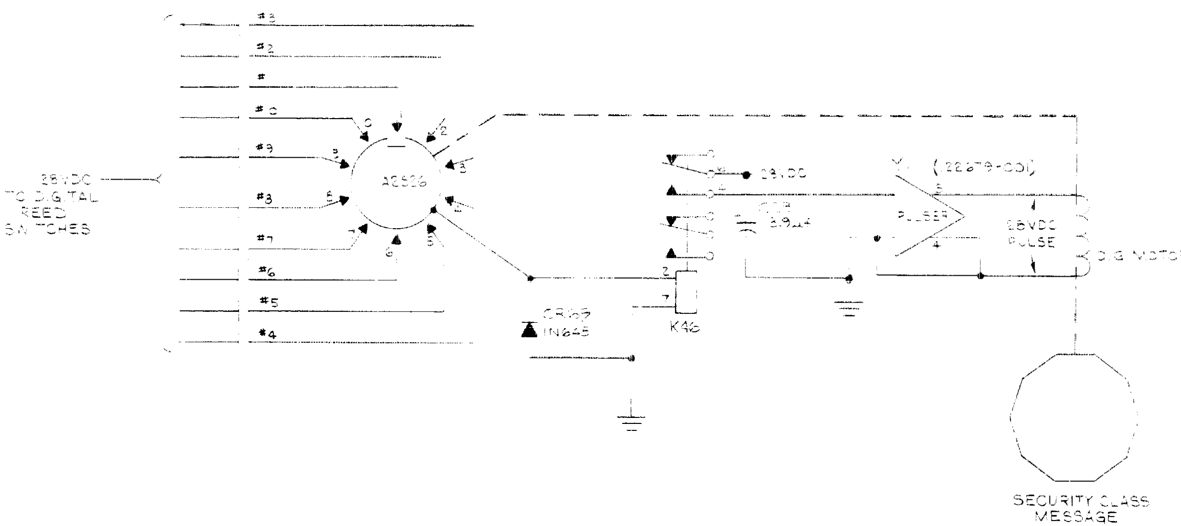


Figure 3-12. Security Classification

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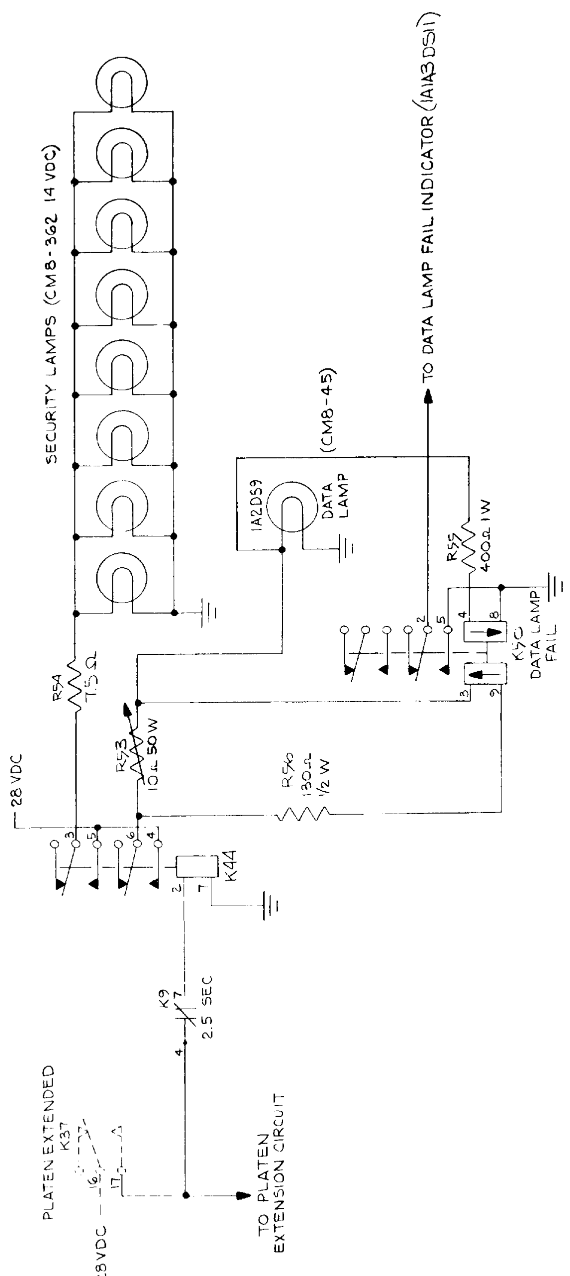


Figure 3-13. Data Lamp, Security Lamp, and Data Lamp Fail

coils. The relay will pull in at about 7.5 vdc with +28 vdc applied to resistor R53 and the data lamp. Resistors R56 and R55 have been chosen so that data lamp fail relay K50 is energized to the up position and ground is removed from the DATA LAMP FAIL indicator. (An illuminated indicator designates a malfunction.) If the data lamp burns out when +28 vdc is applied, there will be approximately zero volts across resistor R53. In addition, +28 vdc will appear across the series-connected relay K50 and resistors R53 and R55, energizing data lamp fail relay K50 to the down position. A ground is supplied to DATA LAMP FAIL indicator 1A1A3DS11 and the indicator illuminates. When a new data lamp is replaced, the voltage across resistor R53 will again energize relay K50 to the up position, and the DATA LAMP FAIL indicator will extinguish.

3-20. PRINT EXPOSURE (figure 3-14). The print lamp is an Osram XB0 150 W/1 high-pressure Xenon short arc lamp. Operating power is 150 watts, drawing 7.5 amps at 20 vdc. In order to strike the arc, it is necessary to ionize the gas with a 20-kilovolt, high frequency (in the order of 1 MHz) starting voltage. The lamp power supply controls this automatically, and as soon as the gas is ionized, the high starting voltage is shut off, and the lamp operates from 20 vdc. This occurs each time the lamp is turned on. When the platens are fully extended, relay K37 energizes. This applies 28 vdc through relay K37-4 and the normally closed contacts of relay 1A3A5K3-4, energizing K57, which applies 115 vac to the Xenon lamp power supply. The high voltage ionizes the gas in the lamp. (This may take anywhere from a few milliseconds to approximately 0.5 seconds.) As soon as the arc is continuous, photo diode 1A1A1V1 (in the lamp housing) senses that the lamp is producing light, and relay K2 energizes due to the conduction of transistor Q11. Ninety-degree nest relay K40 is always energized when the platens extend so that AEC timer relay 1A3A5K3 starts timing as soon as relay K2 energizes. After the prescribed time (set by the AEC servo, which can be anywhere from 0.05 to 2 seconds), AEC timer relay 1A3A5K3 energizes, opening pins 4 and 7, ultimately removing 115 volts, 60 Hz from the Xenon lamp power supply. The lamp extinguishes, diode 1A1A1V1 becomes dark, and relay K2 deenergizes. AEC timer relay 1A3A5K3 is latched across relay K2-5 and 2, so it does not deenergize (the platens are still extended). The platens retract after 2.5 seconds of full extend, and then the turret rotates. As soon as the turret leaves its 90-degree nest position, 90-degree nest relay K40 deenergizes, and AEC timer relay 1A3A5K3 resets itself. There is a small capping shutter in the light housing to

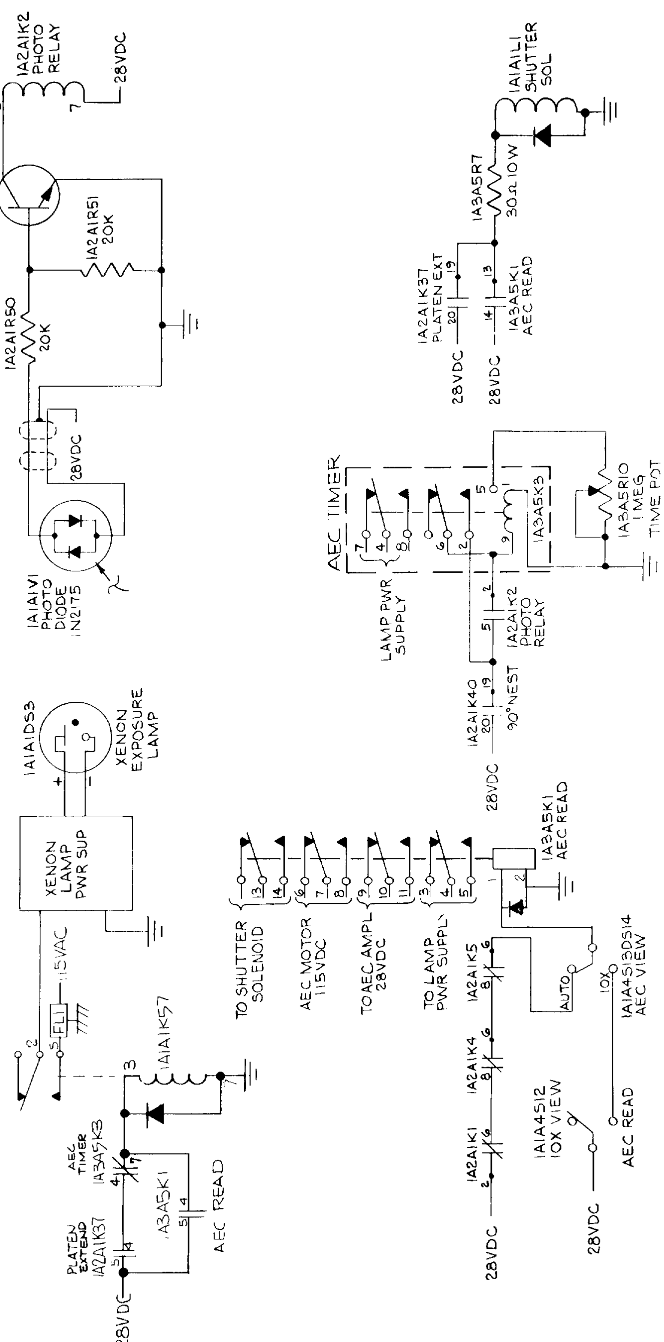


Figure 3-14. Print Lamp & Shutter Solenoid

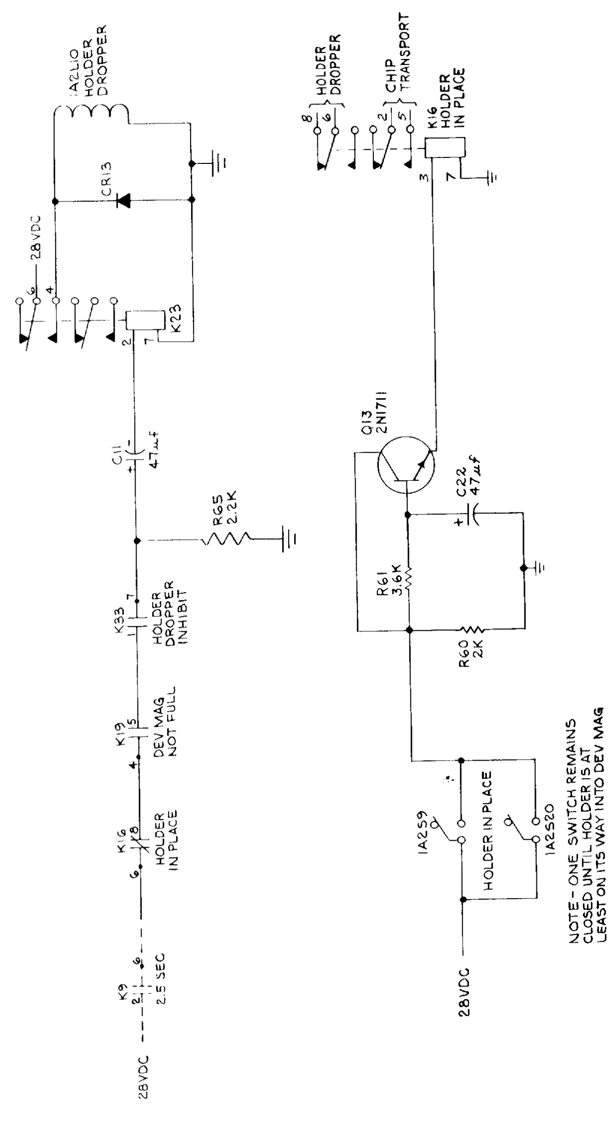
prevent undue exposure of the chip while rotating. This could be caused by the afterglow of the electrodes after the lamp has been turned off. This afterglow lasts only a few seconds. The shutter opens each time the platens fully extend and closes when the platens start to retract. (This is accomplished through the use of platen extend relay K37.)

3-21. CHIP EJECT. When a chip bearing platen arrives at the chip eject station, nothing happens until the platens are fully extended. At that time, vacuum is switched off that particular platen, and air is switched on, blowing the chip off into the chip bender. The vacuum and air sequencing is discussed in paragraphs 3-27 and 3-32 respectively. When the platen retracts, the chip is caught by the chip bender, which bends the chip in the proper direction. The chip now waits in the transport track until the chip transport mechanism carrys it away.

3-22. CHIP HOLDER DROP (figure 3-15). With the platens fully extended, 2.5-second relay energizes (after 2.5 seconds) retracting the platens, which place +28 vdc on the interlock train to holder dropper relay K23. Holder dropper inhibit relay K33 energizes only when a chip-bearing platen is at the eject station. At all other times, holder dropper inhibit relay is deenergized, preventing holder drops. (Refer to figure 3-19 and paragraph 3-28 for further description of the holder dropper inhibit circuit.) Development magazine not full relay K19 will only be energized if there is room in the development magazine for the chip holder that is to be dropped. Holder-in-place relay K16 is energized by a switch in the chip holder track. If there is a chip holder already in the track, the interlock train keeps another chip from trying to drop onto the track. With all conditions fulfilled, relay K23 is pulsed on for approximately 50 milliseconds by capacitor C11. Plus 28 vdc is applied to holder dropper solenoid 1A2L10, and a chip holder drops onto the track below. Switches 1A2S9 and/or 1A2S20 actuate(s) energizing relay K16, which prevents any more holder drops until the holder is safely in the development magazine.

3-23. CHIP HOLDER COUNT. Chip holder counting is accomplished by a 50-microampere meter on the front panel, and ten turn potentiometer R25 attached to the chip holder pusher plate (located in the chip holder box). The current through the meter is in proportion to the number of holders in the box and is calibrated accordingly.

3-24. CHIP TRANSPORT (figure 3-16). When 28 vdc is applied, the chip transport mechanism is driven to one of its limits. Assuming a fore-limit condition, fore-limit switch 1A2S7



NOTE - UNLESS OTHERWISE SPECIFIED PREFIX ALL DESIGNATIONS WITH 1A2A1

Figure 3-15. Chip Holder Dropper

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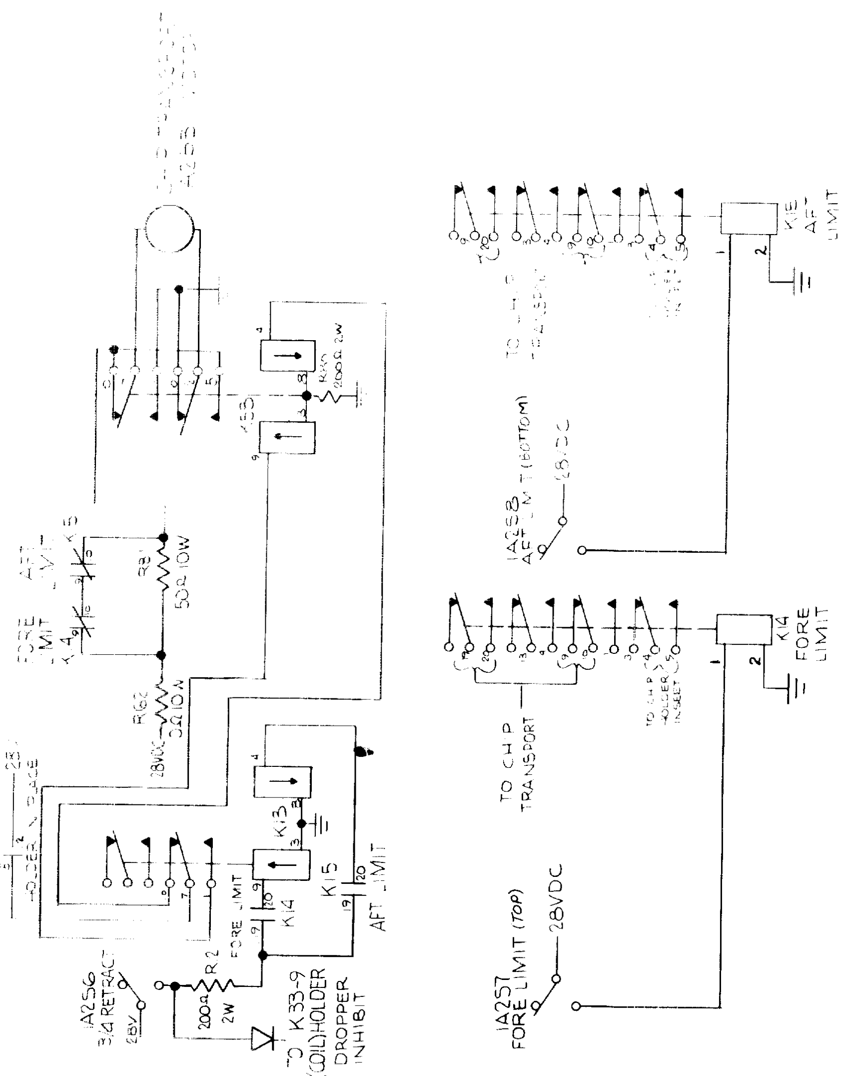

Figure 3-16. Chip Transport

closes, and through the time delay provided by Q12 and C21, fore-limit relay K14 closes and remains closed. Nothing further occurs until the platens have extended and then retracted approximately 3/4 of the way. At this time 3/4 retract switch 1A2S6 3/4 closes. This switch is set so that it closes when the transport mechanism moves. With 1A2S6 and K14 closed, 28 vdc is applied to K13-9, driving it up. If there is a chip holder in the track, holder-in-place relay K16 will be closed, applying 28 vdc to K58-4, driving it down. Plus 28 vdc is applied to chip transport motor 1A2B3 through R62 and K58-5. The transport arms now push the waiting chip along the track and into a chip holder. The track and transport mechanisms are aligned so as to push the chip into the holder and continue pushing the holder and chip combination part way into the development magazine. At this point the transport mechanism moves against a limit stop, in this case the aft limit. Aft-limit switch 1A2S8 closes, actuating aft-limit relay K15. No other relay changes occur since 3/4 retract switch 1A2S6 is not closed at this time (figure 3-9). Power is still applied to transport motor 1A2B3, holding it firmly in the stop, but since aft-limit relay K15 is actuated, 28 vdc is routed through R62 and R81 to reduce heating of the motor. At the next platen 3/4 retract a similar sequence will take place except that the transport will now move in the fore direction.

3-25. DEVELOPMENT MAGAZINE LOADING (figure 3-17). The chip transport mechanism places the chip loaded holder part way into the development magazine. One of the chip transport limit relays K14 or K15 is energized when the transport stops. (Both relays are deenergized when the transport is in motion.) Relay K20 is energized in the up position by capacitor C7. Plus 28 vdc is now applied to capacitor C24, transistor Q14, and relay K22. This voltage energizes relay K22 for approximately 150 milliseconds. The energizing of relay K22 also energizes chip holder insertion solenoid 1A2L9. This pushes the chip holder fully into the development magazine. When chip holder insertion solenoid 1A2L9 reaches the end of its forward travel, it actuates inserter forward switch 1A2S11. The inserter solenoid remains energized and switch 1A2S11 remains actuated for approximately 150 milliseconds. After 150 milliseconds, relay K22 deenergizes. Because the inserter switch and solenoid are mechanical devices, they are fairly slow to return to their normal positions. Therefore, when relay K22 deenergizes, inserter forward switch 1A2S11 still remains actuated for a short period of time. This applies +28 vdc to latching relay K20-4, energizing it in the down position. (All latching relays used in this unit will actuate on a 3-millisecond pulse.)

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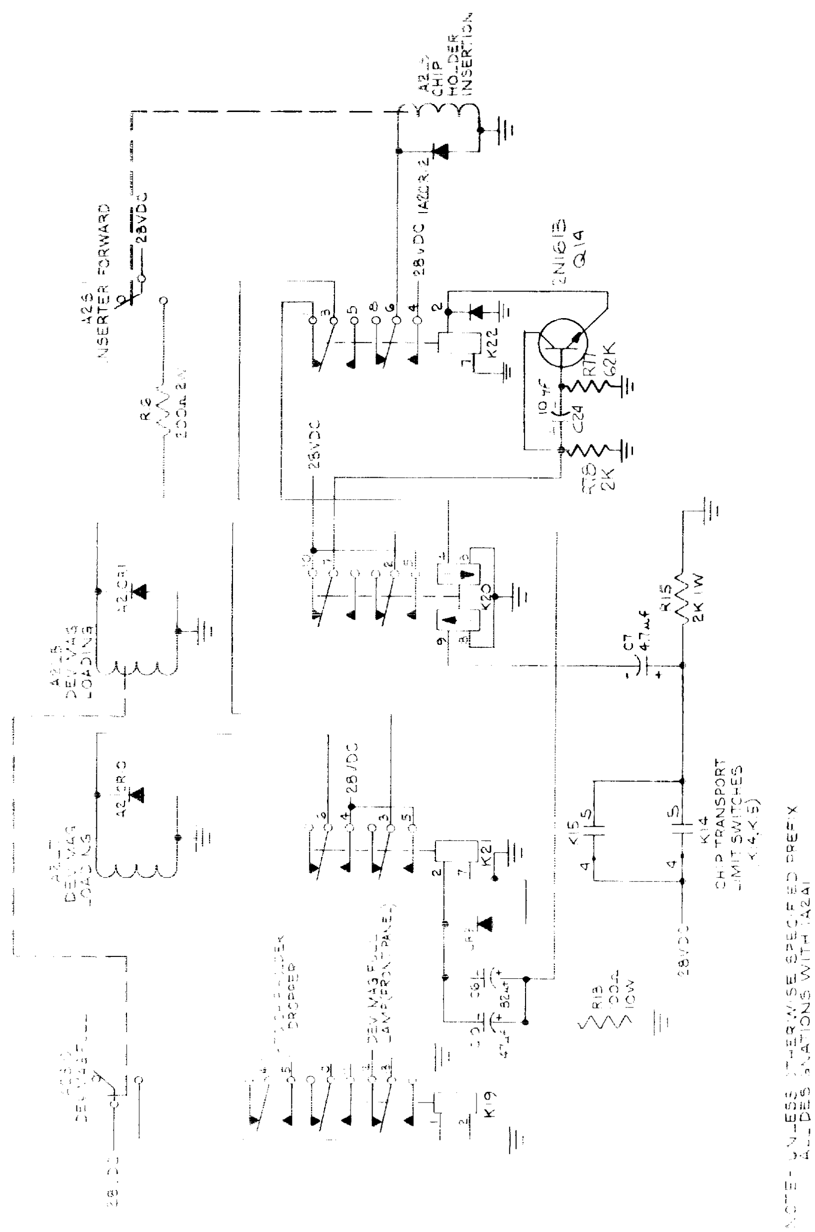

Figure 2-17. Chip Holder Insertion and Development Magazine Loader

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With relay K20 energized, +28 vdc is applied to the parallel combination of capacitors C6 and C10. This energizes relay K21 for about 75 milliseconds. Energized relay K21 applies +28 vdc to development magazine loading solenoids 1A2L7 and 1A2L8. When solenoids 1A2L7 and 1A2L8 energize, driving the chip holder back into the magazine, the doorway is cleared for the next chip holder to enter. If the development magazine is full, the chip holder will not be able to be driven back, and the development magazine loading arms will be unable to actuate development magazine full switch 1A2S10, and relay K19 will be deenergized. There will be no further chip holder drops, the platens will not extend, and the DEV MAG FULL indicator will illuminate. Incidentally, as the chip holder first passes into the development magazine, it will deactuate development magazine full switch 1A2S10 and the DEV MAG FULL indicator will flash briefly during normal operation.

NOTE

> The development magazine should only be installed in the unit with power off; otherwise the loading arms will be pushed back into a position that will indicate that the development magazine is full. This occurs every time, but as soon as power is turned on the loading arms will be raised to the proper position.

3-26. LAST ROTATION. When the required number of chips have been dropped onto the platens, chip counter equal relay K38 energizes (figure 3-19). At this point, there will be a chip on every platen unless the number of chips required is less than four. Then, the number of chips required will be on the platens. No more chips will be dropped, but the chips on the platens must be cycled around to the eject station. Each platen arrives at the eject station and at platen full extend, their respective relays, K28 through K31, are energized in the up position, shutting off the vacuum and turning on the air at that platen. Since chip counter equal relay K38 is also energized, relays K28 through K31 will be unable to be energized in the down position again. When the last chip arrives at the eject station, last-rotate relay K32 will energize through the ground path provided by pins 7 and 10 of relays K28 through K31, respectively. At the instant that relay K32 energizes, the platens are fully extended. When the platens retract (refer to figure 3-7), relay K39 is energized in the up position. Since relay K11 is already energized, +28 vdc is transferred from relay K39-6 to relays

K31-7 and K32-16. With last-rotate relay K32 energized, +28 vdc is applied through relay K32-17 to relay K1 in the dark slide door circuit (refer to figure 3-4). The +28 vdc from relay K32-17 is applied to resistor R8 and diode CR8, energizing relay K1 in the down position. With relay K1 energized, the dark slide doors close, and the run is complete.

3-27. VACUUM SYSTEM (figure 1-3). The vacuum system consists of a two-stage pump and accumulator, with one auxiliary vacuum sensing switch located on the accumulator and four near each platen. The pump is a Precision Scientific Model D-150, rated at 150 liters per minute in free air. It is capable of achieving a pressure of 1×10^{-4} torr, which is more than adequate for the needs of the unit. In addition, the pump is connected directly to a 20-liter accumulator so that the pressure in the vacuum lines is kept stable. An absolute pressure switch (vacuum sensing switch) on the accumulator illuminates the front panel VAC malfunction indicator when the pressure is higher than approximately 200 mm Hg. The vacuum is applied sequentially to the platens, which are made of a porous ceramic and bonded to a steel frame. The uniform porosity of the ceramic surface allows the film chip to be held extremely flat, so as to be consistent with the high-resolution requirements of the unit. Vacuum is applied to each platen through a three-way solenoid valve. There are three ports to the solenoid valve; one port connected to the platen, one port to the vacuum accumulator, and one port to the air supply through another solenoid valve. The three-way valves are referred to as VAC I, VAC II, VAC III and VAC IV, one for each of the like numbered platens. These valves are arranged so that in the vacuum-on position, vacuum is always applied to the platen. However, in the vacuum-off position, air may be applied to the platen, if the proper air solenoid valve is energized.

3-28. VACUUM SEQUENCING (figure 3-10, 3-18, and 3-19).

3-29. Vacuum sequencing switches 1A2S13 through 1A2S16 are mounted on the turret casting, and are actuated by a cam which is fixed directly to the turret rotation shaft. The platens and cam rotate together. (Figure 3-18 shows them in one arbitrary position.) The switches are of concern only when the platens are in a 90-degree nest position. Assume that the unit is at the start of a run, and the platens are positioned as shown in figure 3-18. Relays K28 through K31 (figure 3-19) operate the vacuum solenoid valves on and off. (The up position of these relays turns the vacuum to the respective platen off, while the down

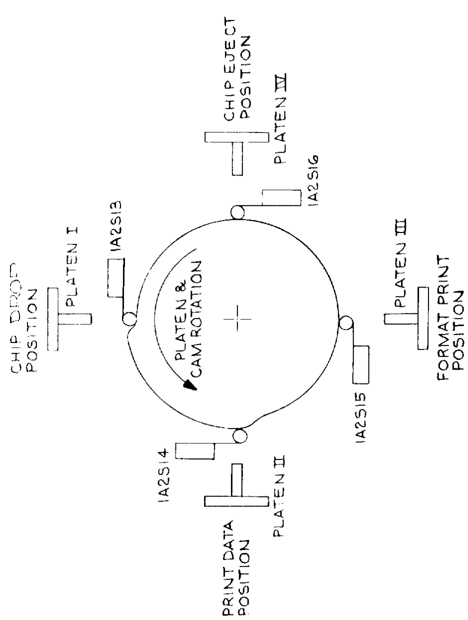

Figure 3-18. Vacuum Sequencing Switches

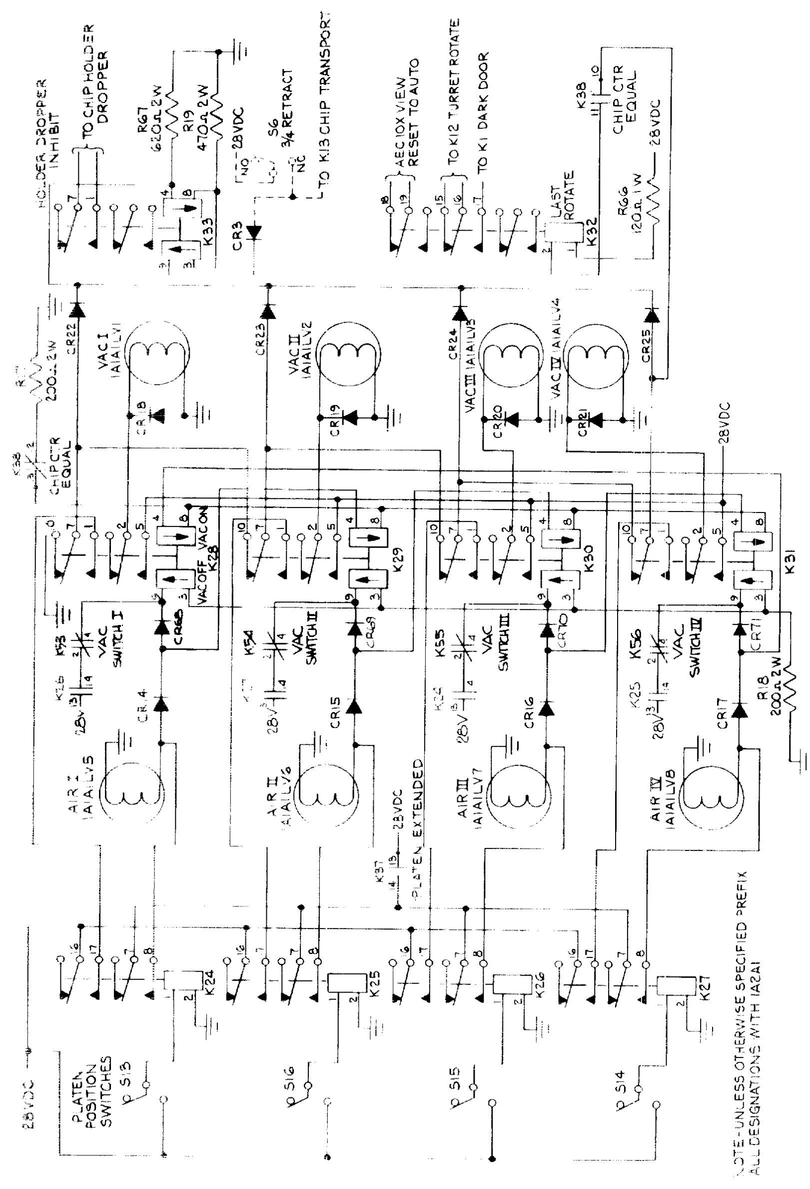

Figure 3-19. Vacuum Air, Last Rotate, and Holder Dropper Inhibit

position turns the vacuum to the respective platen on.) The end of the previous run left relays K28 through K31 energized to the up position; therefore vacuum to all platens will be off. Platen I is at the chip drop position and switch 1A2S14 is actuated, thereby energizing relay K27. When the platen extends, relay K37 energizes. This applies +28 vdc to air IV solenoid valve 1A1A1LV8 placing air pressure on platen IV. There is no chip on platen IV at this time, so this is of no consequence. Plus 28 vdc is also applied through diodes CR17 and CR71 to relay K31-9. Relay K31 is energized to the up position, so there is no change. However, +28 vdc is also applied through diode CR17 to relay K28-4, energizing relay K28 to the down position. This energizes VAC I solenoid valve 1A1A1LV1, applying vacuum to platen I where a chip has been dropped. The platens then retract and rotate. Platen I is now at the data print position, switch 1A2S15 is actuated, and switch 1A2S14 is deactuated. Before proceeding to platen IV, which is now at the chip drop position, note the effect of the contacts of relay K26 and K53 on pin 9 of relay K28.

3-30. In figure 3-10 it can be seen that K53 will indicate, by VAC I switch, whether or not a chip is properly affixed to platen I. If there is no chip there, or if it is improperly registered enough for the VAC I switch to sense it, relay K53 will not energize. With platen I at the data print position, switch 1A2S15 is actuated, energizing relay K26. If relay K53 has not been energized at this time, indicating a poorly registered chip or no chip on platen I, +28 vdc will be applied to relay K28-9, shutting off vacuum to platen I. A similar sequence occurs for each of the other platens. As was previously stated, platen IV is at the chip drop position and switch 1A2S15 is actuated, energizing relay K26. At platen extended, +28 vdc is applied through diode CR16 to relay K31-4, energizing it to the down position. This applies vacuum to platen IV. The other platens follow similarly. When platen I is at the chip eject position, platen II is at the chip drop position and switch 1A2S13 actuates, energizing relay K24. Before the platen is extended, relay K28 is energized to the down position. Vacuum is on at all platens except platen II, which has just arrived at the chip drop position. This places +28 vdc through relays K24-16 and 17 and K28-1 and 7, through diode CR22, to relay K33-4. Relay K33 energizes to the down position, and a chip holder is dropped at the appropriate time to hold the chip which is presently on platen I (figure 3-15). At platen extended, +28 vdc is applied through relay K24-8, through diodes CR14 and CR68, to relay K28-9. This energizes relay K28 to the up position, removing vacuum to platen I. Plus 28 vdc is also applied to air I solenoid valve 1A1A1LV5, which now applies air to platen I, blowing the chip off into the transport track. Vacuum is applied to platen II in a manner similar to the other platens. When the platen retracts 3/4 of the way, 3/4 retract switch S6 actuates, applying +28 vdc through diode CR3 to relay K33-9. Relay K33 energizes to the down position, opening the chip holder dropper path. The circuit is so arranged that a chip holder will only be dropped if there is a chip on the platen at the chip eject position. If the cycle continues, chips will be blown off at the chip eject position, holders will be dropped, and vacuum will be turned back on at the chip drop position.

3-31. When the last chip to be printed has been dropped and received by a platen, chip counter equal relay K38 energizes. The energizing of relay K38 opens contacts 12 and 13, and relays K28 through K31 can no longer be driven down to their vacuum-on position. Therefore, as each platen in turn arrives at the chip eject position, the respective relay (K28 through K31) is energized to the up position, turning off the vacuum. (The vacuum will remain turned off until the next run.) When the last chip-bearing platen arrives at the chip eject position, the last relay (of relays K28 through K31) is energized to the up position. A ground path is made by pins 7 and 10 of each of these relays through contacts 10 and 11 of chip counter equal relay K38 to last-rotate relay K32-2. This energizes last-rotate relay K32, breaking the line to the turret rotate circuit and closing the dark slide doors at platen retract. The run is ended with the dark doors closed, the platens retracted, and all vacuum and air off at the platens.

3-32. AIR SYSTEM. During the following discussion, it would be helpful to refer to the plumbing schematic, drawing No. 1137PS1, not supplied with this manual.

3-33. Platen Air

3-34. Air is delivered to the platens through two-way solenoid valves LV5 through LV8 and three-way solenoid valves LV1 through LV4. The operation of these valves is described in paragraph 3-28.

3-35. Chip Drying Air (figure 3-20 and drawing 1137PS1).

3-36. An air nozzle is located inside the turret assembly for the purpose of drying the gate liquid on the chip before it reaches the chip eject position. This air is controlled by chip

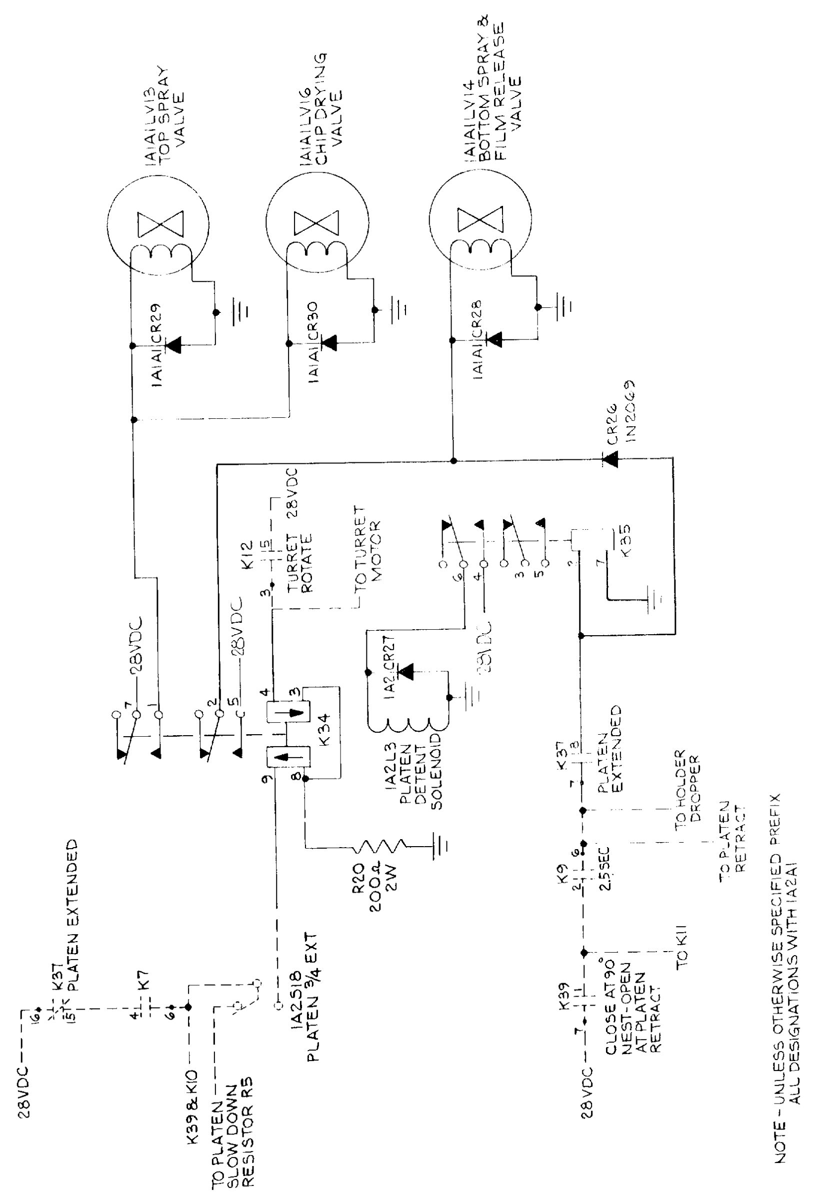

Figure 3-20. Spray Valve, Film Release, and Platen Solenoid

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drying solenoid valve 1A1A1LV16. Each time the turret starts to rotate, relay K12 is energized, and relay K34 is energized in the down position, energizing solenoid valve 1A1A1LV16. When the platen extends 3/4 of the way, platen 3/4 extend switch 1A2S18 actuates, energizing relay K34 in the down position and deenergizing chip drying solenoid valve 1A1A1LV16.

3-37. Cooling Air

3-38. The cooling referred to in this paragraph is distinct from that achieved by the cooling fans. Air is piped into the Xenon lamp housing for cooling purposes. This air comes from the main air regulator and is only shut off when the manual main shutoff valve is closed.

3-39. Liquid Dispensing (figures 3-20 and 3-21, and drawing No. 1137PS1).

3-40. Each time the turret rotates, relay K12 is energized, driving relay K34 to the down position. Top-spray solenoid valve 1A1A1LV13 and bottom-spray solenoid valve 1A1A1LV14 are thereby energized, and liquid gate is sprayed under and over the target film. When the platen extends 3/4 of the way, platen 3/4 extend switch 1A2S18 actuates. This energizes relay K34 in the down position, deenergizing spray valves 1A1A1LV13 and 1A1A1LV14. After the platen fully extends and at the end of 2.5 seconds, +28 vdc is applied to relay K35 to release the platen detent solenoid so that the platens can retract. Plus 28 vdc is also applied through diode CR26 to bottom-spray and film release solenoid valve 1A1A1LV14. This time liquid is sprayed under the target film in order to break the seal formed when the platen comes down on the wet target film. Liquid is sprayed each time the turret rotates, whether or not there are chips on the platens.

3-41. The control of the liquid through the tanks and plumbing is as follows (refer to figure 3-21 and drawing No. 1137PS1). When +28 vdc is applied during initial turn-on, liquid pressure shutoff solenoid valve 1A1A1LV10 is deenergized, allowing air pressure to be applied to port A of three-way solenoid valve 1A1A1LV11. The initial application of +28 vdc to the unit energizes K1 to the down position. Plus 28 vdc is applied through K1-5 to 100-second time delay relay K59-9, starting the timing cycle, and also through the normally closed contacts K59-6 and 3, which energizes 1A1A1LV11. The energizing of 1A1A1LV11 opens ports A and B and closes port C. Pressure is applied through valve 1A1A1LV11 ports A and B to the sump tank. Sump tank vent solenoid valve 1A1A1LV17 and drain shutoff solenoid valve 1A1A1LV18 are both energized so that pressure builds up in the sump tank, forcing any

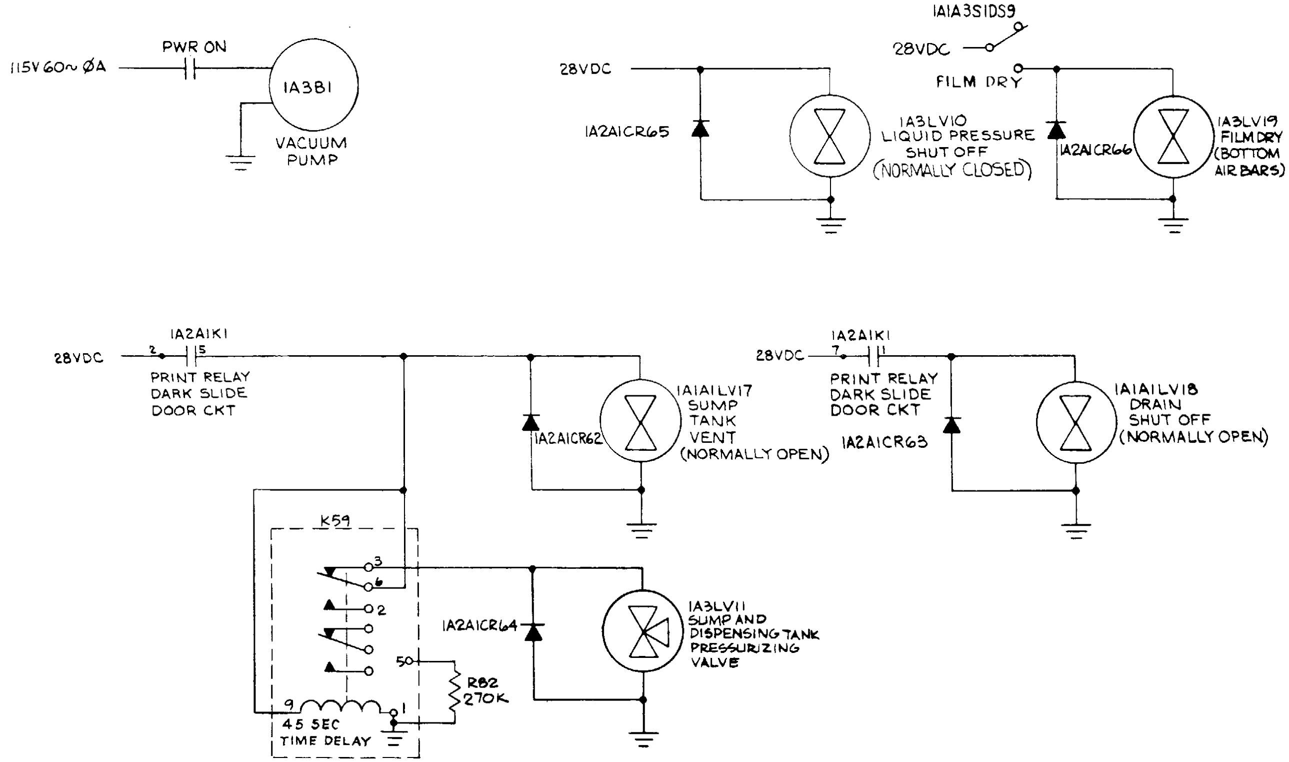

Figure 3-21. Sump Tank, Film Dry Valves, and Vacuum Pump

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liquid through the filter and check valve and then back into the dispensing tank. The pressure in the sump tank is controlled by a relief valve set at 13 psi. There is also a relief valve on the dispensing tank set at 7 psi so that a minimum differential of 6 psi is maintained to force the liquid back into the dispensing tank. After 100 seconds, 100-second time delay relay K59 will energize, removing power from 1A1A11LV11. Ports A and C of three-way solenoid valve 1A1A11LV11 open, while port B is closed. Pressure is applied to the pressure regulator (set for 5 psi), which builds to 5 psi in the dispensing tank. This pressure pumps the liquid out through the spray valves. When the PRINT switch is depressed, all contacts of K1 open and the sump tank vent and drain shutoff solenoid valves 1A1A11LV17 and 1A1A11LV18 are open so that liquid may drain down into the sump tank after it is sprayed onto the film. A vacuum line is attached to sump tank vent solenoid valve 1A1A11LV17 through a small orifice. This small vacuum aids in breaking the air lock which tends to form in the drain line from the drain tray to the sump tank. When printing ceases, all contacts of relay K1 are closed and, as before, pressure is built up in the sump tank for 100 seconds to recycle the used liquid back into the dispensing tank.

3-42. DIGITAL CONTROL ELECTRONICS.

3-43. Figure 3-22 is a block diagram of the digital system. Each block is expanded and illustrated in figures 3-23 through 3-33. The logic circuitry is located in three drawers, A6, A7, and A8 of the electronics console 1A3. The memory system is in drawer A12. The following logic control drawings (LCD's) of the three drawers are required for detailed information on the theory of operation: 1137LCD22 (7 sheets) for A6, 1137LCD21 (7 sheets) for A7, and 1137LCD20 (4 sheets) for A8. These LCD's will accompany this manual under separate cover. Reference designations on the LCD's and connections between sheets for the same LCD will be marked. For example, 1D17X326-1 means zone D17 on sheet 1: X326-1 indicates card connector X326, pin 1. FFA1-111 means flip-flop A1 on card 111. It should be noted that references on the functional diagrams (figures 3-23 through 3-33) such as X118 and X212 are the card locations within a drawer. References such as X118 are used and interchanged with A118 or -118 throughout the theory of operation. Refer to Section V for the correlation between the logic control drawings and the functional diagrams.

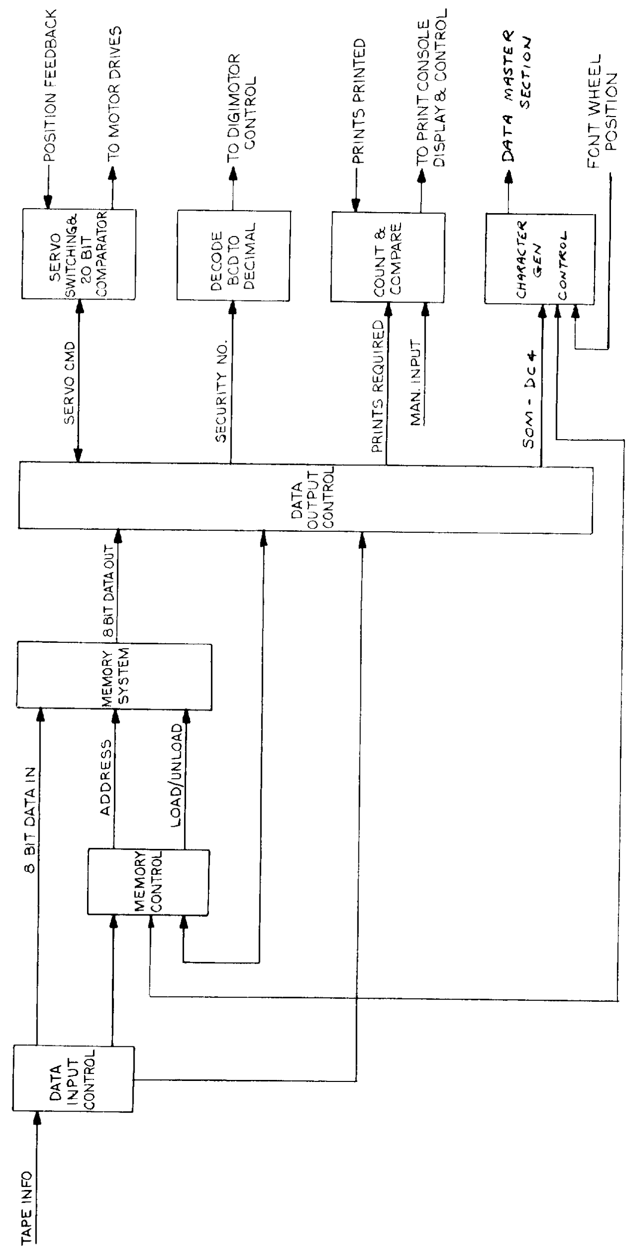

Figure 3-22. Digital and Logic Interface

3-44. The logic cards are germanium 200 kc type, manufactured by Raytheon Computer Corp. Power requirements are -12 vdc and +6 vdc. Logic levels are nominally -10 volts for '1' and zero volts for '0'. One-shot multivibrators (SS) and flip-flops (FF) are triggered on the positive going edge of a pulse or level (that is, from '1' to '0'). With the exception of inverters and reed relays all cards have test points which are connected to the output of each function on the card; test points are numbered from left to right starting at TP1.

3-45. The memory system is manufactured by Ferroxcube Corp. A instruction manual of the memory system will accompany this manual. The encoder counter drawers 1A3A10 and 1A3A11, manufactured by Wang Laboratories Inc., also have separate instruction manuals.

3-46. DATA INPUT CONTROL (figure 3-23 and timing chart 1, figure 3-24). Data from the teletype tape reader is level restored and double railed, providing 16 lines which consist of the eight-bit data and their complements. The TWX synchronizing signal, generated whenever the tape reader interrogates a word on the tape, is a 50 percent duty cycle pulse, 48 volts in amplitude and 50 milliseconds in duration. To facilitate isolation between the teletype unit and input logic, the synch signal energizes reed relay K1-227. The contacts of K1 switch signal ground to the input of one-shot SSA1-117, initiating the 30-millisecond synch pulse.

3-47. The item separator (IS) detector inhibits the synch pulse until IS1 is read from the tape, thus separating the tape leader from the message. The detector consists of an eight-input AND gate A106, inverter A9-327, One-shot SSA1-222, and flip-flop A2-115. The set output of the flip-flop is one input to AND gate A1, A4-109; the two other inputs are the synch pulse and DC4. Therefore, the synch pulse controls the timing generator from IS1 to DC4.

3-48. The control words detectors, carriage return (CR), Line Feed (LF), SOM, EOT, and DC4 are eight-input AND gates A3-111, A5-111, A3-112, A5-112, and A3-113. CR and LF signals may be on tape but will not be stored in the memory system. Therefore, when these signals are detected the write command pulse is inhibited. SOM, EOT, and DC4 detector outputs are ANDED with the delayed synch pulse. This feature allows sufficient time for the TWX data relays to be in a stable state. Otherwise it would be possible for false detection

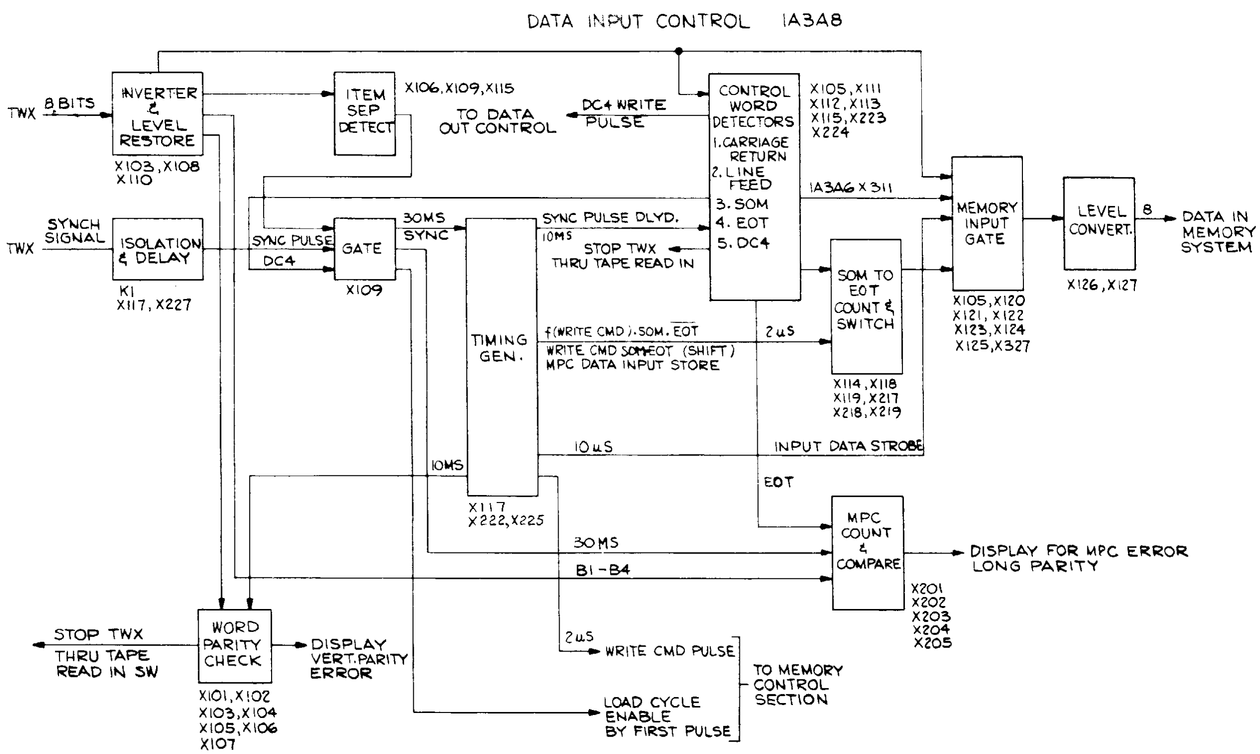

Figure 3-23. Data Input Control

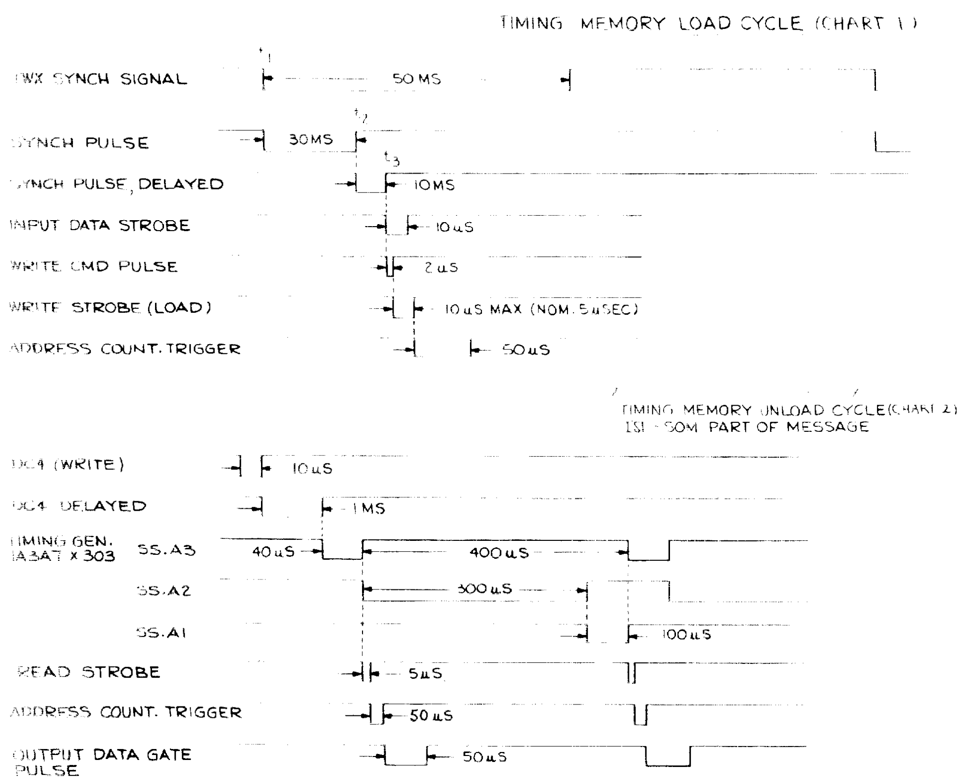

Figure 3-24. Timing Memory Load/Unload Cycles

of the control words. SOM sets FFA3-115, EOT sets FFA1-223, and DC4 sets FFA4-115. DC4 stops the tape reader via reed relay K3-107.

3-49. The timing generator outputs are shown on timing chart 1, figure 3-24. The positive going trailing edge of the synch pulse triggers one-shot SSA2-222, which generates the 10-millisecond delayed synch pulse. The delayed pulse gates the control word detectors and the word parity check circuitry, initiates the input data strobe by triggering SSA2-117, and generates the write command pulse by triggering SSA3-117.

3-50. The SOM to EOT counter (figure 3-23) is a three-decade BCD counter consisting of three cards: A217, A218, and A219. The 1248 outputs of each decade are ANDED with the outputs of a 3-bit shift register SR114. When EOT is detected, SSA1-224 generates a 100-microsecond pulse which triggers the input of SR114. Bit 1 (MSD) is now '1', enabling the MSD 4 line output to be connected to the memory input gate. The write command pulse ANDED (A3-120) with EOT level is delayed 100 microseconds by SSA2-225. This delayed pulse, connected to the shift line of SR214, shifts '1' stored in bit 1 to bit 2 (2 MSD). The second counter decade outputs are now connected to the memory input gate. The next write command pulse shifts '1' stored in bit 2 to bit 3 (LSD), thus connecting the last counter decade outputs to the memory input gate. The next write command pulse clears SR214, disabling the counter outputs. The outputs of SR114 are also used to control the master parity check.

3-51. The Master Parity Check (MPC) counter is a three-decade BCD counter (A201, A202, and A203) which counts every word on the tape from IS1 to EOT, including CR and LF. After EOT, the next three words of input data is the master parity number. The most significant digit (MSD) bit 1 of SR114 enables the four inputs of FF206 to be triggered by the input data; FF206 stores the first word. Similarly, bit 2 of SR114 permits FF205 to store the second word, and bit 3 of SR114 permits FF204 to store the last MPC word. A comparison of the MPC counter outputs and the MPC flip-flop outputs is made (drawing 1137LCD20, sheet 3). If there is an inequality, the comparator output will energize K4-107, resulting in the illumination of the LONG PARITY ERROR indicator lamp.

3-52. The memory input gate consists of a combination of AND-OR gates (drawing 1137LCD20, sheet 4). Input data from IS1 to EOT, with the exception of CR and LF, is stored in the memory system. Master parity data on the tape is not stored. In place of the MPC words, data from the SOM to EOT counter, which is a word count of the total number of machine-readable characters to be printed on the data master, will be stored in the memory. The write strobe pulse is the common connection to the eight 2-input AND gates, A124 and A125, providing the required pulsed data for storage.

3-53. The level converters are used to make the negative logic levels compatible with the positive logic levels required for the memory operation. Word parity check circuitry (drawing 1137LCD20, sheet 4) examines each input word for even parity. If odd parity is detected, FFA1-115 will be set, thus energizing K2 and K3-107. K3 will stop the TWX tape reader via the TAPE READIN switch; K2 will illuminate the VERT PARITY ERROR indicator lamp.

3-54. MEMORY CONTROL (figures 3-24, 3-25 and drawing 1137LCD21, sheet 5). The function of the memory control is to load and unload the memory system in the required sequence. The load cycle is initiated when the first synch pulse from the data input control section triggers the load/unload (L/U) flip-flop FFA1-205, permitting the write command pulse to pass through AND gate A3-208. This triggers one-shot SSA2-209, generating the start pulse. At this time the P-counter, A215 and A216, forms an eight-bit binary counter. Outputs are all binary 0. This number represents the storage location (address) for IS1, the first word of input data. The P-counter is used for addressing during the load cycle; the Q-counter's A217 and A218, output gates are disabled at this time.

3-55. The 3-microsecond start pulse is ANDED with the load level by A2-327, forming the memory load command pulse. In addition, the start pulse triggers SSA3-209, generating a 50-microsecond pulse. The positive going edge of this pulse triggers the P-counter via AND gate A5-208. Therefore, after a word is stored, the P-counter output selects the address for the next word to be stored. The last input word generates the DC4 write pulse, which resets the address counters and resets FFA1-205, ending the load cycle.

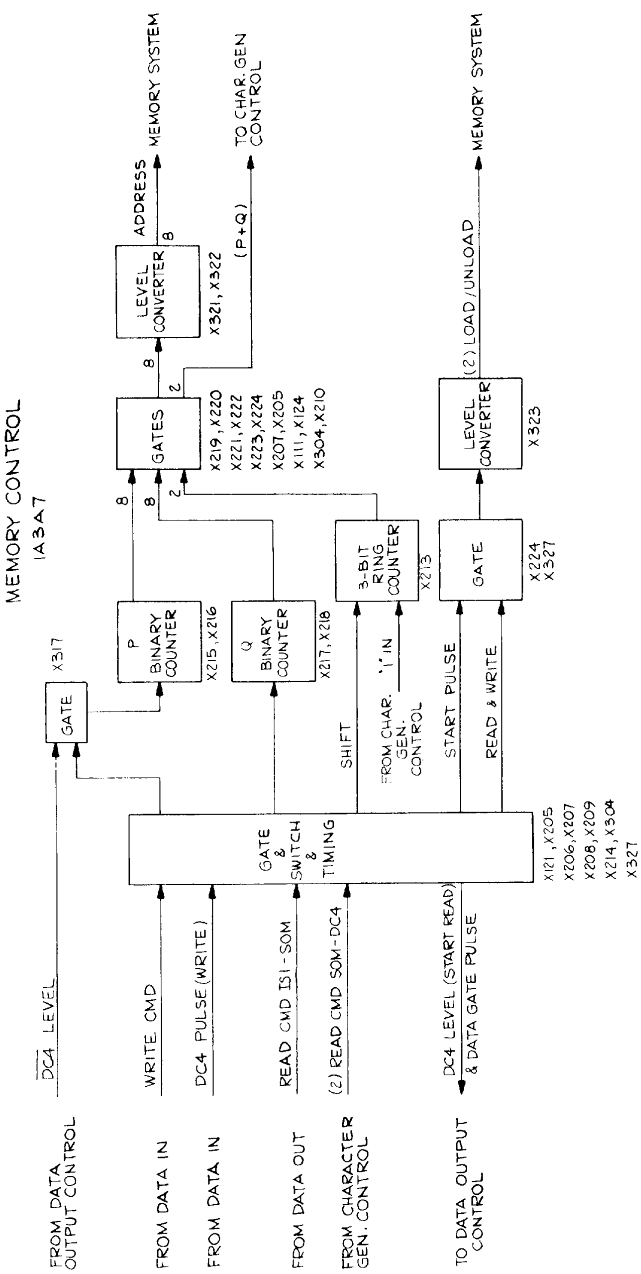

Figure 3-25. Memory Control

3-56. The transmission path of the read command pulses, which trigger the start pulse one-shot is similar to the path described in the load cycle. The only difference in the unload cycle is that the start pulse is ANDED with the unload level to form the memory unload command pulse. Generation of the read command pulses will be described in the discussions of the functions which interface with the memory control input.

3-57. MEMORY SYSTEM. The Ferroxcube Series FX-12 are coincident-current ferrite core memory systems with a maximum capacity of 512 words, 8 bits per word. The access time is ≤1.5 microseconds. The minimum cycle time (read/restore or clear/write cycle) is 10 microseconds. The system includes an address register, selection and drive circuits, a data register, and timing control circuits. Silicon planar epitaxial semiconductors are used throughout. All electrical connections are made at the 50-pin input/output connector.

3-58. The Series FX-12 uses cordwood module construction for the logic circuits. The modules and the ferrite core matrix are mounted on the three glass-epoxy printed circuit cards which plug into the card cage from the front of the system. Test points are provided at the front edge of each card for all relevant timing and logic functions.

3-59. The timing and data logic card accommodates all the internal timing control circuits, the data control, and the inhibit driver circuits. The address and selection logic card contains the address input circuits and the matrix drivers, which direct the read and write currents through the core matrix. Mounted on the matrix card beside the core matrix are the sense preamps and diode modules. The memory system manual describes the characteristics and operation of the system, with an analysis of each circuit. Also included are circuit schematics, troubleshooting information, and timing diagrams.

3-60. DATA OUTPUT CONTROL (figures 3-26 and 3-28, timing chart 2 on figure 3-24, and drawing 1137LCD21, sheets 6 and 7). Level converter A320 changes the positive data levels from the memory system to the required negative logic levels. The memory outputs are gated with the unload level from L/U flip-flop. These output gates are necessary because the data registers in the memory system are used for both writing and reading core data. There are eight control word detectors: item separator (IS), plus, minus, space, SOM, EOA, EOT, and DC4. The use of these detectors will be discussed in the sequence in which they control the various functions.

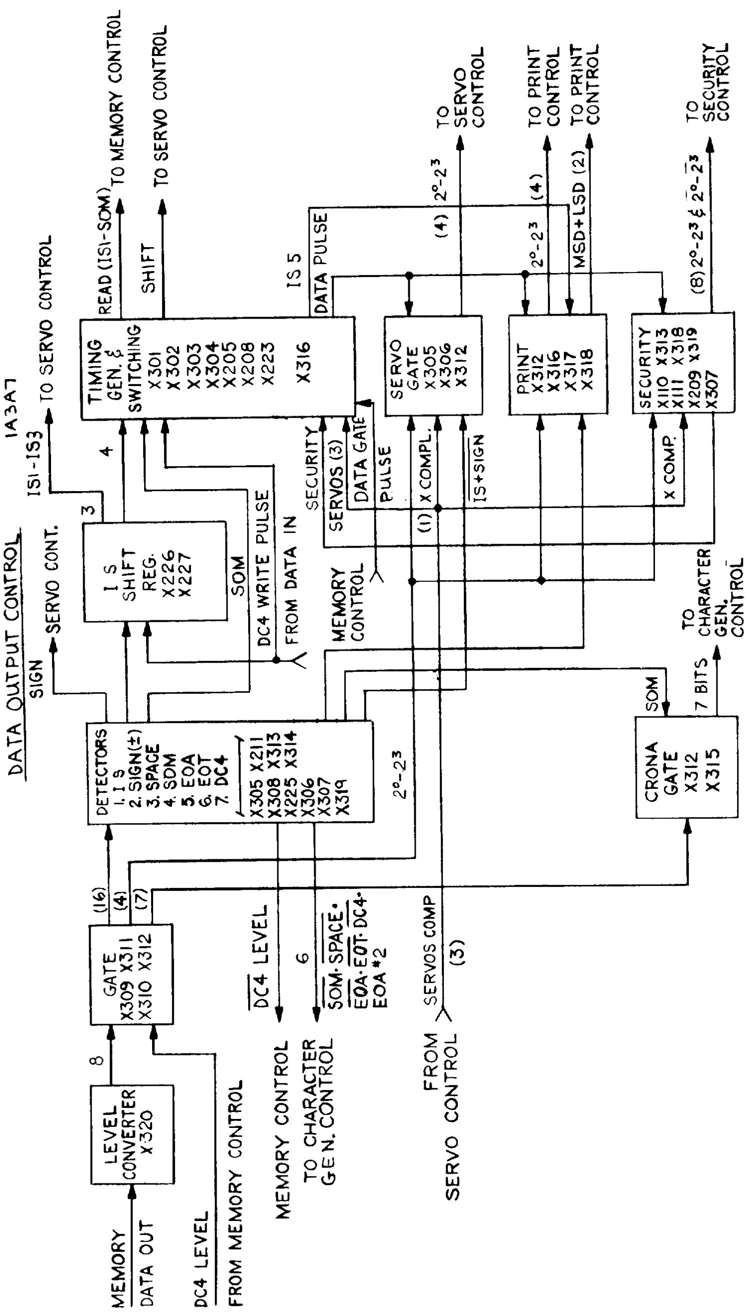

Figure 3-26. Data Output Control

3-61. One-shots SSA3, SSA2, and SSA1 of 302 are connected to form a timing generator. SSA3 generates a 40-microsecond pulse which triggers SSA2 to produce a 300-microsecond pulse. This in turn, triggers SSA1 to produce a 100-microsecond pulse. The output of SSA1 is connected to the input of SSA3 through a two-input AND gate A4-208 and a three-input OR gate A5-223. The DC4 write pulse triggers the IS shift register SR226 and SSA2-302, generating the DC4 delayed pulse. This delayed pulse starts the timing generator via OR gate A5-223. The reset output of flip-flop A4-205 is connected to the other input of AND gate A4-208, controlling the timing generator. The output of the timing generator is the read command pulse to the memory control and the shift pulse input to the servo control.

3-62. The first word read from the memory is IS1. The IS detector (A2, A3, and A7-305) triggers SSA3-308 whose 10-microsecond pulse output is connected to the shift line of the IS shift register SR226 and SR227. When IS2 is detected, the shift register transfer triggers SSA3-301, generating a 10-microsecond pulse which sets FFA4-205 via a four-input OR gate, A4 and A6-223. The reset output of FFA4-205 is now '0'. This inhibits the timing generator pulse train, stopping the memory read command pulses. The Y servo command data is between IS1 and IS2. The first four bits (2^0 through 2^3) are gated with the following signals: $\overline{\text{IS}}$, $\overline{\text{minus}}$, $\overline{\text{plus}}$, $\overline{\text{X}}$ $\overline{\text{complete}}$, and the data gate pulse from SSA3-316, which is controlled by the address count trigger in the memory control. Four-line pulsed data from A1, A4-305 and A1, A4-306 is sent to the servo control section with sign information: a plus (+) level from A5-225 and a minus (-) pulse from SSA2-308. A Y complete pulse from the servo section triggers the timing generator and resets FFA4-205, enabling read command pulses to continue unloading the memory.

3-63. Control of the timing generator is implemented in a manner similar to that described in the preceding paragraph for the remaining output data until the SOM word is detected. Item separator words will stop the pulse train; servo complete (Az and X) and security pulse signals will retrigger the generator.

3-64. The IS4 level from SR227 ANDED with the data gate pulse sets FFA4-111, triggering SSA1-209 whose output is gated with the four (2^0 - 2^3) data lines through A1, A4-307 and A1, A4-313. These four gates set the security classification flip-flops FFA2, A3, A4-318 and FFA1-319.

3-65. When IS5 is detected, the PRINTS number data circuitry is enabled. The circuitry consists of four 2-input data AND gates, A1, A3, A5, A7-317; flip-flop FFA1-318 establishes MSD (most significant digit) and LSD (least significant digit) levels. The output of AND gate A5-312 enables the MSD data to be pulsed by SSA2-316. The positive going edge of this pulse triggers SSA1-109, which sets FFA1-318, thus enabling the LSD level. The next data gate pulse enables the LSD data to be processed.

3-66. The SOM detector output pulse from SSA1-308 will set FFA4-205, stopping the timing generator. Read command pulses for the remainder of the message stored in the memory will originate from the character generator control section. Seven-line level data is sent to the character generator control through seven 2-input AND gates A-315 and A4-312, gated by the SOM flip-flop FFA2-319.

3-67. SERVO CONTROL (figures 3-27 and 3-28 and drawing 1137LCD22, sheets 1, 2, 3, 4, 5 and 7). The servo control section inputs from the data output control consist of four data lines, a direction pulse for Y and X servos, IS levels, and shift pulses coincident with memory read commands. One digital 20-bit comparator is used and time-shared for all three axes (Y, Az, and X). Therefore, position inputs from the encoder counters are switched externally in 1A3A9. In Y and X, one encoder pulse represents 0.1 millimeter; in Az, 1 pulse equals 0.1 degrees.

3-68. The 21-bit register consists of 21 J-K flip-flops. One flip-flop, FFA1-115, is for sign data; the other 20, in groups of 4, store a five-digit decimal number. The X number will utilize all 20 flip-flops; the Y and Az numbers will use only 16. The MSB (most significant bit) for X is 20, and the MSB for Y and Az is 16. Refer to table IV for circuit identification.

3-69. Each output of the five-bit shift register, SR119 and SR120, is connected to a group of four flip-flops of the 20-bit register (drawing 1137LCD22, sheet 1). The MSD level from the shift register is used to gate the inputs of the X MSD flip-flops. The second MSD level will gate the Y or Az MSD flip-flops or the X second MSD flip-flops, etc. The LSD level will of course gate the inputs to the LSD flip-flops.

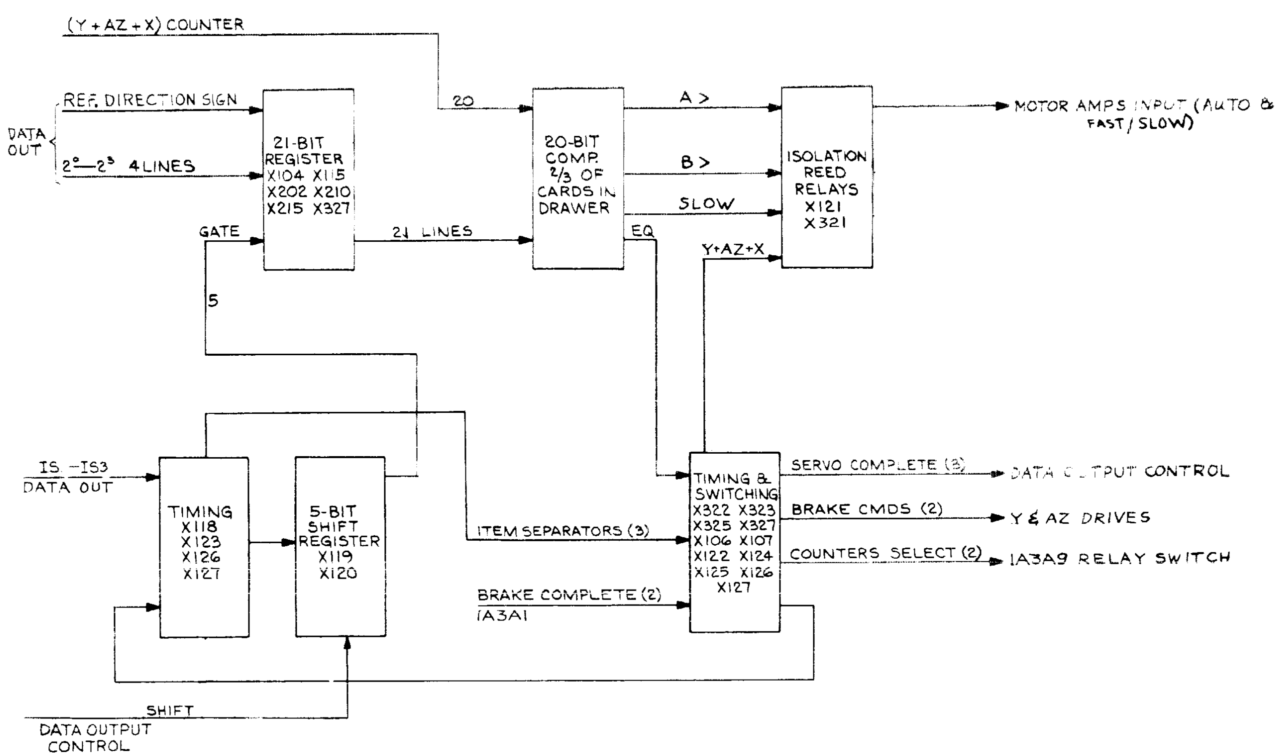

Figure 3-27. Servo Control (Sheet 1 of 2)

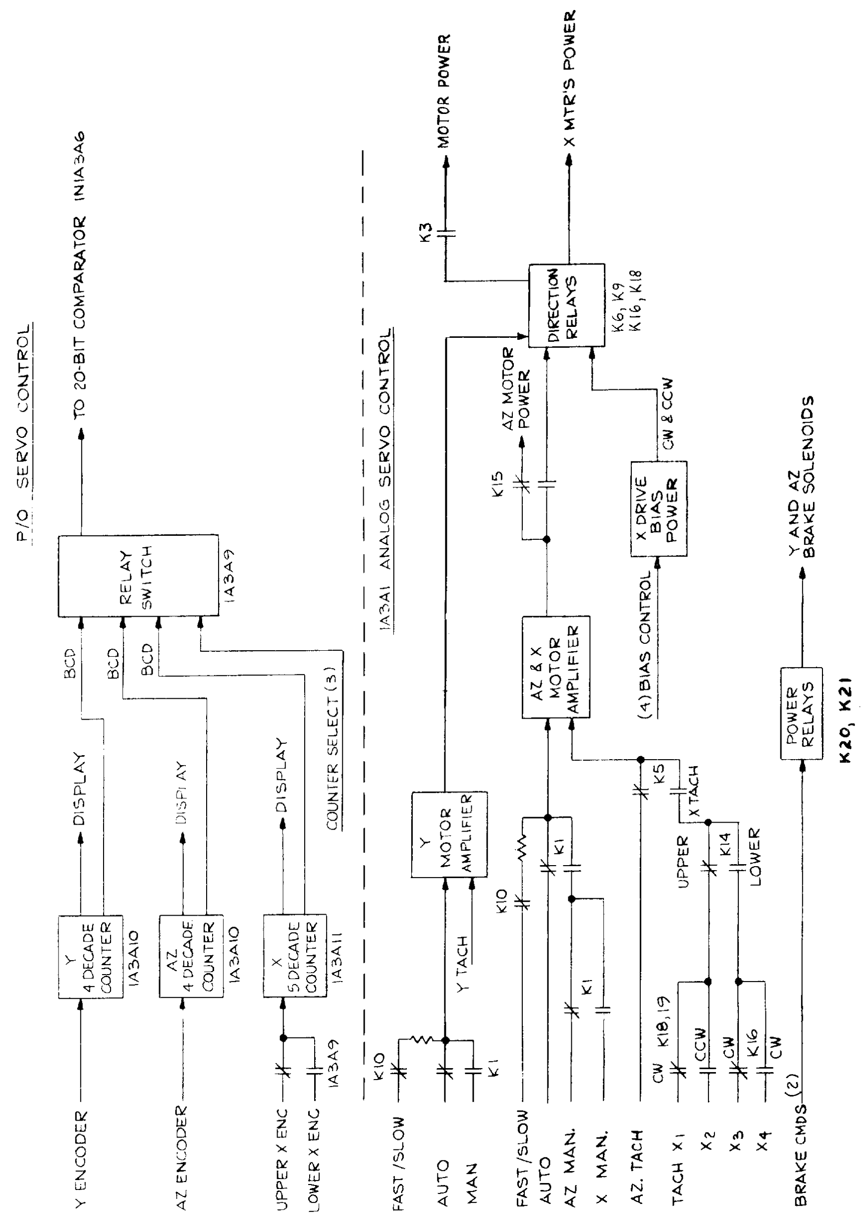

Figure 3-27. Servo Control (Sheet 2 of 2)

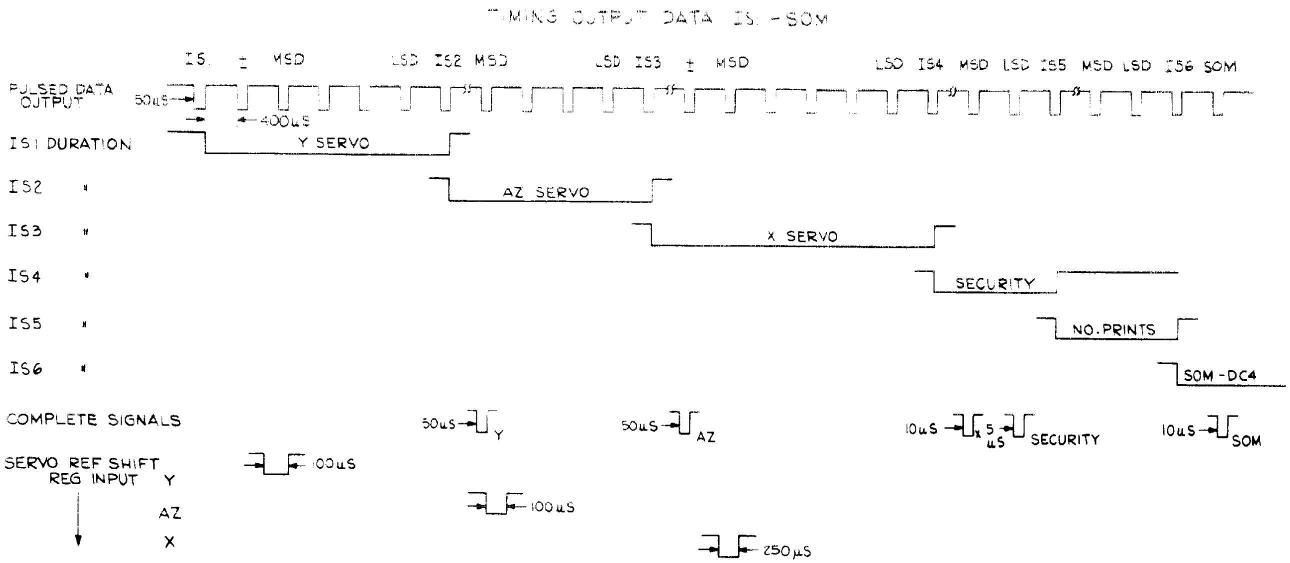

Figure 3-28. Timing Output Data IS1-SOM

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TABLE IV. SERVO CONTROL CIRCUIT IDENTIFICATION

BIT NO.	FLIP-FLOP	TP	DATA LINE	
20	A2-115	3	2^3	
19	A3-115	2	2^2	MSD X1
18	A4-115	1	2^1	
17	A1-104	4	2^0	
16	A2-104	3	2^3	
15	A3-104	2	2^2	MSD Y1, Az1, X2
14	A4-104	1	2^1	
13	A1-202	4	2^0	
12	A2-202	3	2^3	
11	A3-202	2	2^2	Y2, Az2, X3
10	A4-202	1	2^1	
9	A1-210	4	2^0	
8	A2-210	3	2^3	
7	A3-210	2	2^2	Y3, Az3, X4
6	A4-210	1	2^1	
5	A1-215	4	2^0	
4	A2-215	3	2^3	
3	A3-215	2	2^2	LSD Y4, Az4, X5
2	A4-215	1	2^1	
1	A1-327	4	2^0	

3-70. The IS1 level triggers one-shot SSA1-123 providing a delayed pulse to trigger SSA2-123, which generates a 100-microsecond pulse. The delay is necessary to ensure coincidence with the shift pulse and the MSD input pulse. That is, the sign data pulse should not control the shift register. The output of SSA2-123 is connected to the second stage input of SR120 via a three-input OR gate, A2-122. The second MSD level is now set, enabling the Y1 MSD flip-flops to be triggered by their corresponding data lines. The next shift pulse transfers the SR output to Y2, thus enabling the Y2 flip-flops. Each succeeding pulse shifts the enabling level to gate the 20-bit register in the proper sequence until the entire Y number is stored. The IS2 level energizes reed relays K7 and K8 of A121, connecting the A >B > outputs of the comparator to the input of the Y-motor maplifier. In addition, the IS2 level energizes K4-121, which removes the Y-brake via power relay K20 in 1A3A1.

3-71. The 20-bit comparator is shown in detail on drawing 1137LCD22, sheets 2, 3, 4, 5 and 7. The circuitry is basically redundant one-bit full comparators. The outputs of the 20-bit register will be called A20 through A1; outputs from the encoder counters will be named B20 through B1. Consider a single bit for simplicity of operation. Each comparator consists of three outputs: A = B, A> B and B > A. Functionally, equal (EQ) is true when $A \cdot B + \overline{A} \cdot \overline{B} = '1'$; A > B when $A \cdot \overline{EQ} = '1'$, and B >A when $B \cdot EQ = '1'$. Note that only one of the three outputs can be true at any given time. Bits 20 to 16, bits 15 to 9, and bits 8 to 1 are grouped to form separate comparators. For servo control the higher order bits must be equaled before the lower bits become effective.

3-72. The servo error signal is developed between the A > B and B > A outputs. If A >B, then A is '1' (-10 volts) and B is '0' (zero volts); when B > A, then B is '1' and A is '0'. Since the encoder counter output is initially zero, that is, all B bits are '0', then A > B and the direction of the servo drive is determined by the sign of flip-flop FFA1-115. A positive (+) sign will leave the sign FF reset, and a negative (-) sign will set it. When bits 20 to 9 are equal, K1-321 is energized, this produces the slow CMD, which energizes the fast/slow relay K10 in 1A3A1. The result is a decrease in the amplitude of the motor amplifier input voltage, which produces a slower drive speed and enables the servo to approach a null. When all bits are equal, FFA1-325 (EQ 1) will be set thus initiating the following events: deenergizing K4-121, resulting in the application of the Y-brake, and receiving a Y-clamp complete signal from 1A3A1. This triggers SSA1-125, which in turn triggers SSA1-124, generating the Y complete pulse signal. The output of SSA1-125 triggers the flip-flop reset inputs to all FF's in the 21-bit register, and in addition, triggers reset gate RGA2-326, thus resetting the five bit shift register. The Y complete pulse sets flip-flop A2-327, which energizes K2-321. This produce the counter select signal and causes the relay switch in 1A3A9 to release the Y encoder counter output from the comparator input and activate the Az encoder counter output to the comparator input.

3-73. The Y complete pulse is delayed through 2 one-shots, SSA2 and SSA3-124. The output of SSA3-124 will be coincident with the Az MSD shift pulse, thus enabling the Az MSD level of the five-bit shift register. Storage of the Az number in 16 flip-flops of the 21-bit register is accomplished as described for the Y number. When the IS3 level is '1' the IS2 level is '0'. This releases the Y amplifier inputs through K7 and K8 of A121 and energizes K1 and K2 of A121, connecting the output of the comparator to the input of motor amplifier No. 2. This amplifier is time-shared with the Az and X servos. At this time K15 in 1A3A1 connects the output of the amplifier to the Az motor. Reed relay K6-121 is energized, removing the Az brake via power relay K2, in 1A3A1. When the Az servo is positioned at a null, the comparator equal output sets flip-flop (EQ2) FFA2-325, which releases K6-121, applying the Az brake. An Az clamp complete signal from 1A3A1 is ANDED with FFA2-325 set output via A2-127, which triggers one-shots SSA3 and A2-125. SSA3-125 output pulse resets the 21-bit register and the five-bit shift register. The EQ2 flip-flop energizes K3-321, which causes the counter select relay switch in 1A3A9 to remove the Az encoder counter and apply the X encoder counter output to the comparator input. The output of SSA2-125 is the Az complete pulse, which is used to trigger SSA1-118 and SSA2-118. The output of SSA2-118 will be coincident with the X MSD shift pulse, thus enabling the X1 level of the five-bit shift register. Storage of the X number in the 20 flip-flops of the 21-bit register is similar to that described for the Y number. Removal of the IS3 level causes K15 contacts in 1A3A1 to switch the motor amplifier No. 2 from the Az motor to one of the X motors.

3-74. Comparator operation for the X servo is similar to the other two axes, however, there are differences. First, there are no mechanical brakes, second, the servo remains in operation until prints are made of the film in the requested position. The equal output of the comparator sets flip-flop (EQ3) FFA4-327. The set output energizes reed relay K4-321, which causes the SERVO POS COMPL lamp to illuminate on the lower left control panel.

3-75. The analog part of servo control is shown in functional form on figure 3-27, sheet 2 in greater detail on schematic 1137SD9 (1A3A1). Motors, tachometers, brakes, encoders, and potentiometers are shown on print console schematic 1137SD13, sheet 1. The potentiometer shafts are connected to sensing arms, which are in contact with the film spool, thus providing a variable resistance proportional to spool diameter. Each potentiometer is a dual control; one is used for varying the bias voltage, maintaining a near constant film tension; the other potentiometer is used as a speed adjust. Each servo has a minor feedback loop. A tachometer coupled to the motor shaft provides a signal to the motor amplifier where it is summed with the digital comparator error signal, thus aiding servo stability.

3-76. The Y and Az servo control is relatively simple but the X is more complex. The film drive (upper or lower track) consists of two drive motors (torquers). The motors are powered, via the bias supplies, to drive in opposing directions, thus applying a tension force to the film. If the applied force provided by each torquer is equal or almost equal, there will be no film motion. With an error signal, the motor amplifier output will add voltage to one of the torquers. The direction sensing relays select the torquer. The added voltage causes an unbalanced tension force which produces film motion. In this condition one torquer is driving and the other one, still with bias power, is driven in the same direction as the driver. As the X servo comes to a null, the error voltage is absent, and the motor amplifier output is reduced to zero. If the bias to each torquer does not produce equal and opposite forces, the ΔF will cause the film to move, the encoder will detect this motion, and the comparator will develop an error signal to null the servo. If this ΔF is not decreased, the X servo will oscillate about the null. Since it is virtually impossible to maintain an automatic balance without the aid of a separate servo, a manual balance control is incorporated. This control is located above the joystick on the lower right control panel.

3-77. The film footage counters are electromechanical add and subtract impulse counters. Two small bar magnets attached to a film roller control the operation of a reed switch. The contacts of the reed are closed twice per one revolution of the film roller, providing a pulse equal to 0.2 foot of film length. These pulses are shaped and gated in 1A3A7, (drawing 1137LCD21, sheet 1).

3-78. Manual control of the drives Y, Az, and X is performed in 1A3A1 via the appropriate switches and potentiometers on the control panels. The motor amplifier input signals are developed by the joystick and the azimuth control.

3-79. SECURITY NUMBER (figure 3-29). The security number is stored in four flip-flops, FFA2, A3, A4 of 318 and FFA1-319. The set and reset outputs of these flip-flops are connected to ten 4-input AND gates, which decode the BCD number to a decimal number 0 to 9. Refer to drawing 1137LCD22, sheet 6. Outputs of the AND gates control the operation of all reed relays on 317 and A1 and A2 of card 316. The reed relays switch +28 volts to control the digimotor position. At any given time only one reed can be energized; the other nine will be open.

3-80. PRINTS CONTROL (figure 3-30 and drawing 1137LCD21, sheets 2, 3 and 4). Data for the number of prints required originates from the data output control in the auto mode and from the thumbwheel selector switches in the manual mode. The four data lines (2^0 - 2^3) are connected to the set inputs of the corresponding flip-flops in the eight-bit register. The MSD level is connected to one of the set inputs of FFA1-125, FFA2-125, FFA1-201, and FFA2-201. The eight-bit register will store the two-digit prints required number. Relays K1, K2, and K3 of 127 select the prints required number from either the eight-bit register or the thumbwheel switches. Both numbers are of the same form, that is, eight BCD levels and their complements. This number is presented to display drivers card A114, A115, A116, and A117. Each display driver card consists of six BCD to decimal matrices and six lamp drivers. The driver outputs display the two-decade number on the lower left control panel.

3-81. The print command signal triggers one-shot SSA2-109. This generates the count pulse which triggers the prints counter. A112 and A113 are connected to form a two-decade BCD counter. The counter output is decoded to two decimal numbers through display driver cards A117, A202, A203, and A204. The driver output displays the PRINTS PRINTED number on the lower left control panel.

3-82. The BCD outputs of the prints counter and the BCD prints required number are compared bit for bit in the eight-bit equal comparator. When the two numbers are equal the comparator output energizes reed relay K1-A123, switching +28 volts to the chip control

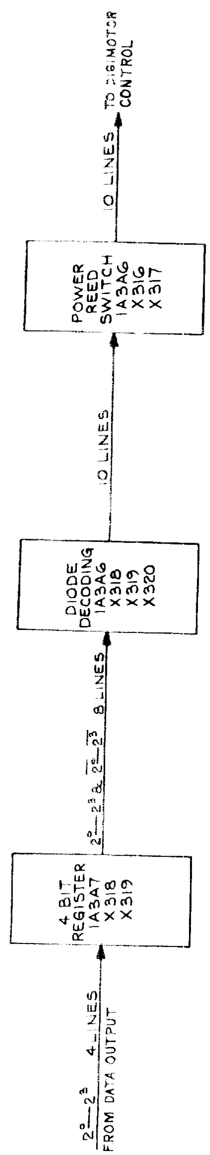

Figure 3-25. Security Number

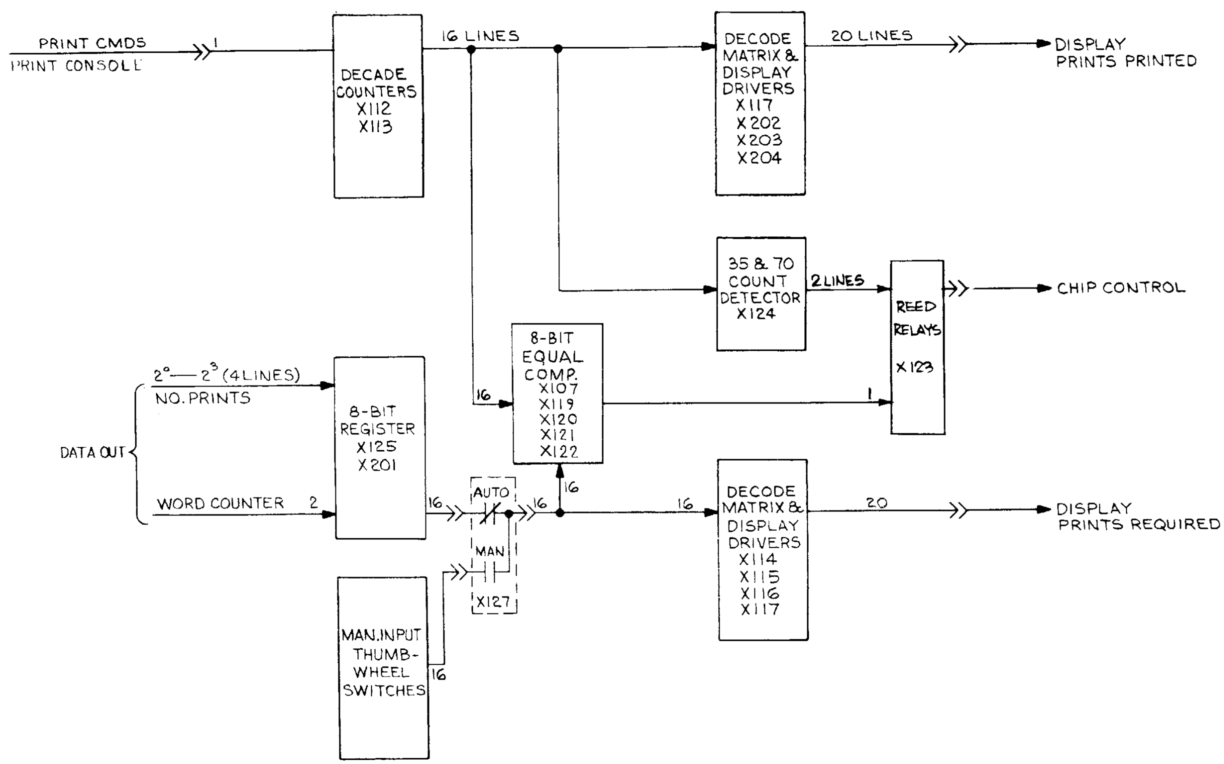

Figure 3-30. Number of Prints Counter and Displays

section and stopping the print command signal. Whenever the prints counter output number is 35 or 70, the respective detectors will energize reed relays K2 or K3 of A123. These relays perform the same function as K1-A123.

3-83. CHARACTER GENERATOR CONTROL (figures 3-31 and 3-32). The function of this section is to make a data master of the memory data from SOM to DC4. The stepper motor is mechanically coupled through gearing to the font wheel and the encoder. Characters on the Font wheel consist of two types: alphanumerics (α-n) and the ASCII eight-bit code with a timing mark (machine characters). Alphanumeric characters are located on 0.056-inch centers and machine characters are 0.028-inch wide. The position feedback device is a seven-bit, 128-word Grey code encoder. The data master carriage is indexed precisely in 0.028-inch increments and is driven linearly so that the master passes between the font wheel and the hammers assembly. These hammers are controlled by the α-n and machine solenoid actuators. Since the carriage is indexed to an increment equal to the machine character width, then α-n characters, twice as wide, cannot be printed sequentially with their corresponding machine characters. Table V lists the sequence for printing a test message consisting of the alphabet, space, +, -, · , numbers 0 to 9, EOA, EOT, MPC numbers (3), and DC4.

3-84. Refer to drawings 1137LCD22, sheet 6 and 1137SD2, sheet 1 for details of the carriage control. When logic is reset, either automatically or by the control panel switch, flip-flops FFA1-313 and FFA2-313 are reset, producing the following: reed relay RRA5-316 is energized, which in turn energizes K48 on 1A2A2 and applies 60 Hz power to the index motor; reed relay RRA4-316 is energized, which in turn energizes K49 on 1A2A2 and reverses the index motor direction. The output of AND gate A3-314 is '1', making the output of OR gate A3-315 '1'. This energizes reed relay RRA3-316 and applies 12 volts to the index solenoid. The carriage will move until switch S27-1A2 is actuated, causing AND gate A3-314 to go to '0'. This deenergizes RRA3-316 and removes power from the solenoid and stops the carriage at the alignment position (SOM). The carriage is now indexed incrementally by the index advance pulse via OR gate A3-314. When the last character is printed FFA1-313 is set, causing the following: RRA4-316 is deenergized and the index motor direction is reversed; the output of AND gate A4-314 is '1', applying 12 volts to the index solenoid. The carriage now returns to the complete position, actuating switch S28-1A2 and causing AND

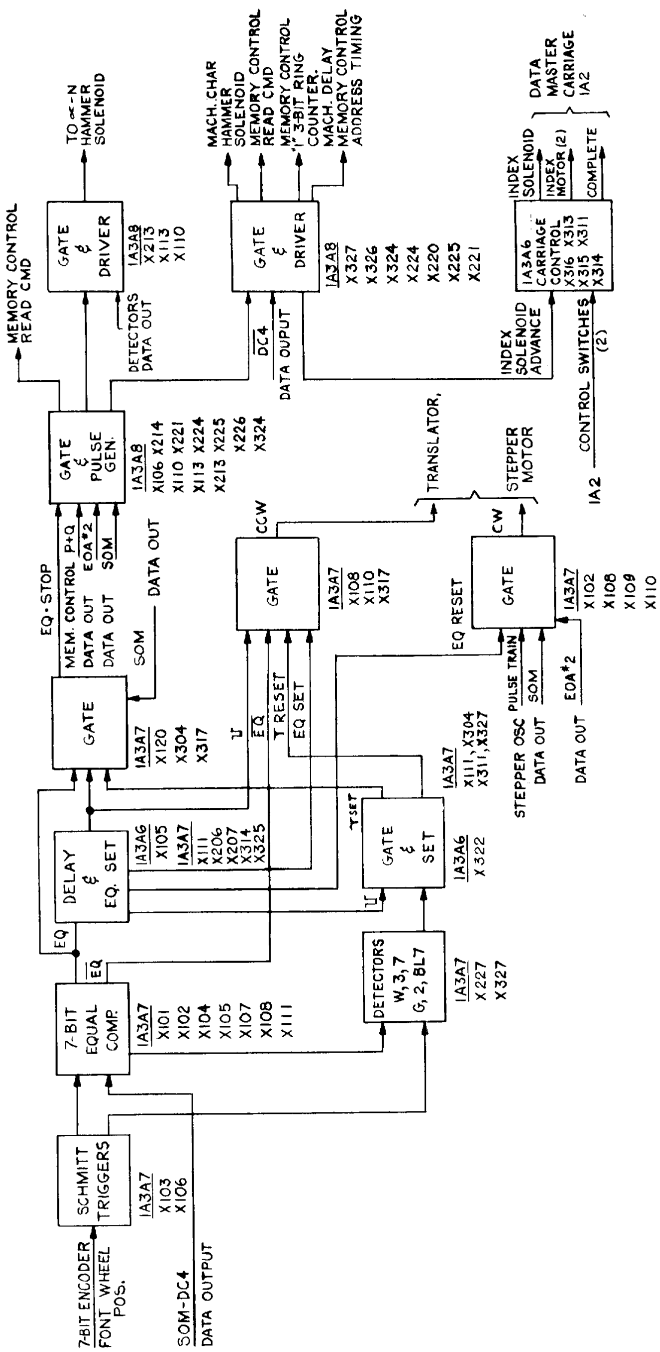

Figure 3-31. Character Generator Control

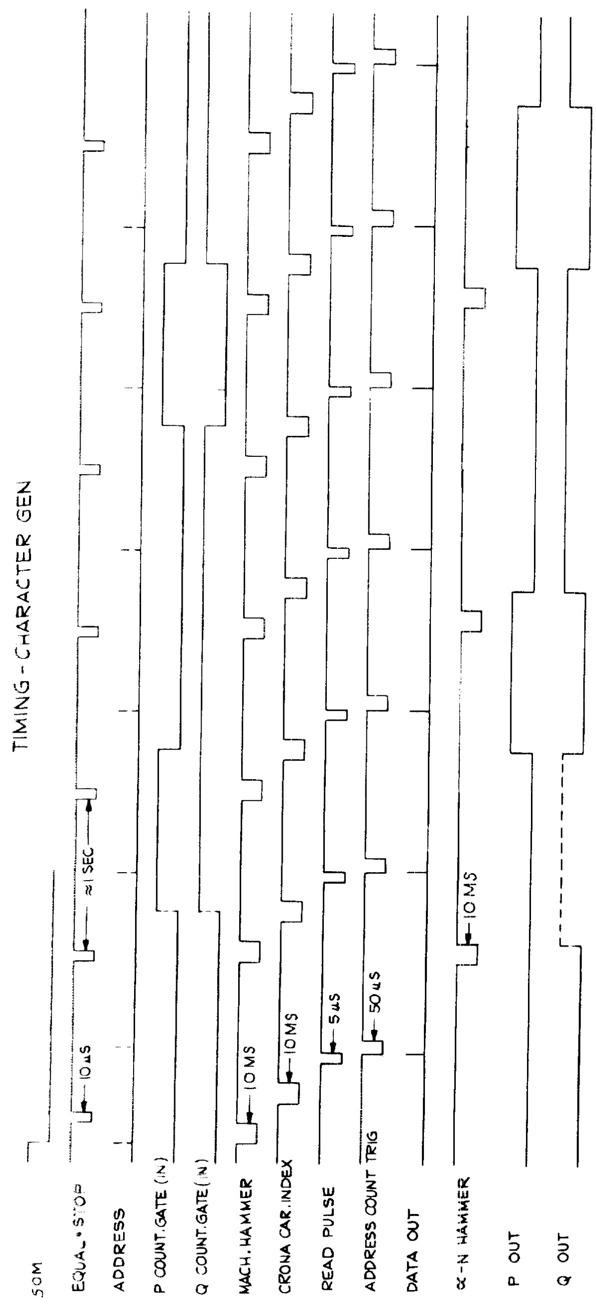

Figure 3-32. Timing-Character Generator

TABLE V. TEST MESSAGE PRINTING SEQUENCE

Memory Address	Carriage Position	Word Printed	
		α-n hammer	Mach. hammer
25	1		SOM
26	2	A	A
27	3		B
27	4	B	
28	4		C
29	5		D
28	6	C	
30	6		E
31	7		F
29	8	D	
32	8		G
33	9		H
30	10	E	
34	10		I
35	11		J
31	12	F	
36	12		K
37	13		L
32	14	G	
38	14		M
39	15		N
33	16	H	
40	16		O
41	17		P
34	18	I	
42	18		Q

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TABLE V. TEST MESSAGE PRINTING SEQUENCE (cont)

Memory Address	Carriage Position	Word Printed	
		α-n hammer	Mach. hammer
43	19		R
35	20	J	
44	20		S
45	21		T
36	22	K	
46	22		U
47	23		V
37	24	L	
48	24		W
49	25		X
38	26	M	
50	26		Y
51	27		Z
39	28	N	
52	28		Space
53	29		+
40	30	O	
54	30		-
55	31		.
41	32	P	
56	32		O
57	33		1
42	34	Q	
58	34		2
59	35		3
43	36	R	

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TABLE V. TEST MESSAGE PRINTING SEQUENCE (cont)

Memory Address	Carriage Position	Word Printed	
		α-n hammer	Mach. hammer
60	36		4
61	37		5
44	38	S	
62	38		6
63	39		7
45	40	T	
64	40		8
65	41		9
46	42	U	
66	42		EOA
67	43		EOT
47	44	V	
68	44		O
69	45		4
48	46	W	
70	46		3
*71	47		DC4
49	48	X	
71	48		
71	49		
50	50	Y	
71	50		
71	51		
51	52	Z	
71	52		
71	53		

TABLE V. TEST MESSAGE PRINTING SEQUENCE (cont)

Memory Address	Carriage Position	Word Printed	
		α-n hammer	Mach. hammer
52	54		
71	54		
71	55		
53	56	+	
71	56		
71	57		
54	58	-	
71	58		
71	59		
55	60	.	
71	60		
71	61		
56	62	0	
71	62		
71	63		
57	64	1	
71	64		
71	65		
58	66	2	
71	66		
71	67		
59	68	3	
71	68		
71	69		
60	70	4	
71	70		

TABLE V. TEST MESSAGE PRINTING SEQUENCE (cont)

Memory Address	Carriage Position	Word Printed	
		α-n hammer	Mach. hammer
71	71		
61	72	5	
71	72		
71	73		
62	74	6	
71	74		
71	75		
63	76	7	
71	76		
71	77		
64	78	8	
71	78		
71	79		
65	80	9	
71	80		
71	81		
66	COMPLETE		

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gate A4-314 to go to '0'. This removes index solenoid power and sets FFA2-313, which de-energizes RRA5-316 and energizes RRA6-316. The index motor power is removed, and the data master complete signal is generated.

3-85. Refer to drawing 1137LCD21, sheet 1 and figures 3-25, 3-31 and 3-32). SOM, the first character to be printed from the memory, is compared with the encoder word by the seven-bit equal comparator. The encoder data is shaped and double railed by Schmitt triggers ST103 and ST106. The stepper motor, which drives the font wheel and encoder, is controlled by the comparator. When flip-flop FFA1-111 is reset the stepper will drive in the clockwise direction. The pulse train drawing 1137SD2, sheet 1, assembly 1A2A2, is ANDED with the reset output of FFA-111 via A4-108. These pulses, 250 per second control the switching of the stepper motor translator.

3-86. When the comparator detects equality, one-shot SSA1-105 in 1A3A6 is triggered, generating a 5-millisecond pulse. This pulse sets FFA1-111 and triggers SSA3-206 through a two-input OR gate, A1-207. One-shots SSA3-206 and SSA3-314 provide a 1-second delay in triggering SSA1-325, which generates a 50-microsecond pulse. Since FFA1-111 is set, the stepper pulse train is inhibited and the motor stops. Because of the 5-millisecond delay between comparator EQ and stop, the font wheel has been allowed to overshoot by at least one position; the comparator $\overline{EQ}$ is now '1'. The output of SSA1-325 is enabled to pass through AND gate A6-108, thereby pulsing the stepper motor in the counterclockwise direction until the comparator EQ level is '1'. At this time the font wheel is at the SOM print position and the EQ · stop pulse is generated and passes through AND gate A8-120.

3-87. Refer to drawing 1137LCD20, sheet 2 for details on the print hammers control. The EQ . stop pulse is common to both hammers. The 'P' and 'Q' levels from the memory control section (figures 3-25 and 3-32) determine the hammer to be actuated. The 'P' level enables the EQ · stop pulse to trigger one-shot SSA1-222 generating the machine character pulse. This pulse, via AND gate A2-106, energizes reed relay K52 (drawing 1137SD2, sheet 1), which saturates Q1 and applies 60 vdc to machine hammer solenoid L17, actuating the machine character hammer. The output of SSA1-222 triggers FFA2-223 and SSA2-224, generating a 10-millisecond pulse and providing a delayed trigger to SSA3-224, which generates the advance carriage index pulse. The index pulse, in addition to moving the carriage, is fed to OR gate A3-226. The output of this gate is the read command pulse for the memory data from SOM to DC4. The next word out of the memory, refer to table V, is 'A'. The font wheel will be positioned to the 'A' print position in the same manner as described in the preceeding paragraph. In figure 3-32 note that for the second EQ · stop pulse, both the machine character hammer and the α-n character hammer are actuated simultaneously. In addition, note that the mach. hammer pulse and the 'P' out level are coincident and the α-n hammer pulse and the 'Q' out level are coincident. The 'P' and 'Q' levels are functions of the three-bit shift register outputs, SR213, shown on drawing 1137LCD21, sheet 5. The α-n hammer pulse is initiated by SSA3-225 whose output is routed to the hammer solenoid control via AND gate A4-113. When K53 is energized, saturating Q2 and applying 60 vdc to L18, the α-n hammer is actuated. The output of SSA3-225 also produces the READ command pulse via OR gate A3-226 and AND gate A8-214 and triggers FFA3-326. This in turn triggers SSA1-225, producing one pulse per message to enable the 3 bit shift register. The shift line to SR213, 1A3A7, is pulsed by the delayed read command pulses via SSA2-206, 1A3A7.

3-88. Refer to drawing 1137LCD21, sheet 5 for details of the 'P' and 'Q' gating levels. The P and Q counter inputs are controlled by toggle flip-flop FFA3-205 which is triggered by the data master carriage index pulse from 1A3A8. The P and Q counter outputs, that is, which counter is addressing the memory at any given time, are determined by the shift register states. Refer to figure 3-32 and note that after the third EQ · stop pulse, the timing is repetitive.

3-89. Due to encoder defects, the words W, 3, and 7 are of insufficient width and cannot be relied upon to align with their corresponding characters on the font wheel. To compensate for these three words, seven-input AND gates are used as detectors for the three words and their adjacent words. Consider whenever the memory output word is W, the W detector is ANDED with the G detector output, and the G detector monitors the encoder Schmitt trigger outputs. When both detectors are '1', SSA1-322 in 1A3A6 is triggered producing a trigger pulse to set flip-flop FFA3-111. The set output of FFA3-111 is the pseudo-equal level and is used in place of a real equal level from the comparator. The EQ · stop pulse can now be generated and the W word is now printed. The machine character hammer pulse is inhibited after DC4 is printed. The α-n hammer pulse is inhibited whenever EOA is detected for the second time. This EOA No. 2 level returns the data master carriage to the complete position.

3-90. LOGIC RESET. The logic reset momentary indicating switch located on the lower left control panel is connected to one input of the two-input AND gate A5-327 (drawing 1137LCD21, sheet 5). The other input to this gate is the auto-initial logic reset. Normally both inputs are '1'; when either or both are '0' one-shot SSA1-211 is triggered, generating the reset pulse. The output of SSA1-211 is connected to the double inverter A3 and A4 of 210, thus increasing the drive capability of the pulse. The reset line is connected to the other two logic drawers via J1-CC and J1-DD of 1A3A7.

3-91. The auto-initial logic reset, the other input to AND gate A5-327, originates from the time delay relay K2 (drawing 1137SD10). K2 is energized when PS2 the 28 vdc power supply is initally powered. Within five seconds of power-on, the contacts of K2 switch signal ground to reed relay RR8-316 (drawing 1137LCD22, sheet 6), actuating the reed triggers one-shots SSA1 and A2 of 309. The output pulse is inverted by A2-310 and sent to 1A3A7 and to 1A3A9 for initial reset of the encoder counters via reed relays K12, K13 and K14 (drawing 1137SD4).

3-92. POWER SUPPLIES (drawing 1137SD4). PS4 furnishes -12 vdc for logic and is the source for the -4.5 vdc regulator providing lamp power for the data master 7 bit encoder. PS3 furnishes +6 vdc for logic. PS2 supplies 19 vdc, which powers the following regulators: VR3 and VR4 provide the +12 vdc required for the memory system; VR1 and VR2 are matched 8-volt reference diodes, providing positive and negative signal power for the Y, Az and X manual controls. Drawing 1137SD12 shows the connections for the data master stepper motor power supply, located in 1A3A4.

SECTION IV

TROUBLESHOOTING AND MAINTENANCE

4-1. GENERAL.

4-2. This section contains troubleshooting, replacement, cleaning, and adjustment procedures for the Chip Format Printer. In Table VI, the troubleshooting guide, reference is made to additional schematics not included in this manual. A summary list of these schematics is presented in Section V.

TABLE VI. TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	CORRECTION
1. Dark slide doors do not open (figure 3-4)	1a. Doors are rubbing against a platen.	1a. Manually release platen retract detent and manually retract platens.
	1b. Relays inoperable.	1b. Check K1, K5, K41 and K4.
2. Dark slide doors do not close (figure 3-4)	2a. Doors are rubbing against a platen.	2a. Manually release platen retract detent and manually retract platens.
	2b. Printing run is not fully or properly complete.	2b. See appropriate entrys.
	2c. Relays inoperable.	2c. Check K1 and K3.

TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
3. Platens do not extend (figure 3-7)	3a. Dark slide doors not completely open.	3a. See 1 above.
	3b. Platen retract detent and cam are not in the locked position.	3b. Shut off power and manually set detent to the locked position. Start the run again.
	3c. Turret not in a 90-degree nest position.	3c. See 5 below.
	3d. Relays inoperable.	3d. Check K7, K8 and K6.
4. Platens do not retract (figures 3-20 and 3-7)	4a. Platen detent solenoid did not energize.	4a. Check 1A2L3 and K35.
	4b. Relays inoperable.	4b. Check K6, K9 and K39.
5. Turret does not rotate (figure 3-7)	5a. Platens not completely retracted.	5a. Manually retract platens.
	5b. Platen retract detent and cam is not in locked position.	5b. Shut off power and manually set detent to the locked position. Start the run again.
	5c. Turret detent solenoid did not energize.	5c. Check K8, K12, Q9 and 1A2L6.
	5d. Relays inoperable.	5d. Check K39, K11, K45, and K12.

TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
6. Chip transport does not operate (figure 3-16)	6a. Chip holder not in track. 6b. Chip holder not seated properly in track. 6c. Relays inoperable.	6a. See chip holder entry. 6b. Remove chip holder and start the run again. 6c. Check K13, K14, K15, and K58.
7. Chip holders do not drop (figure 3-15)	7a. Chip holder hooks are bent. 7b. Chip holder supply teflon tracks are dirty. 7c. Development magazine is full. 7d. A chip has not been delivered to the chip eject station. 7e. Relays inoperable.	7a. Remove holder and straighten. 7b. Clean tracks. 7c. Shut off power and install empty magazine. 7d. See appropriate entries. 7e. Check K19, K33, and K23.
8. Chip holders do not go into development magazine (figure 3-17)	8a. Previous chip holders are jammed in the development magazine. 8b. Development magazine not properly locked in place.	8a. Remove magazine and clear jam. 8b. Lock development magazine.

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TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
8. (cont)	8c. Relays inoperable.	8c. Check K20, Q14, K22, 1A2L9, K21, 1A2L7, and 1A2L8.
9. Chip drop fails to drop (figure 3-6)	9a. Chips improperly loaded or jammed in the chip cassette.	9a. Reload chip cassette.
	9b. Rubber rollers need cleaning.	9b. Refer to paragraph 4-11.
	9c. Relays inoperable.	9c. Check K10, K60, and K61.
10. AEC fails to operate properly (figures 3-3, 3-5, and 3-14)	10a. Xenon exposure lamp did not light.	10a. Lamp burned out or spark gap needs adjusting (refer to paragraphs 4-7 and 4-13).
	10b. Filter wheel not in proper position.	10b. Check filter wheel circuits.
	10c. FILM TYPE switch set for wrong film.	10c. Set switch to proper film type.
	10d. Circuit malfunction.	10d. See figures 3-3, 3-5 or 3-14.
11. Print lamp fails to light (figure 3-14)	11a. Lamp power supply spark gap needs adjusting.	11a. Adjust spark gap (paragraph 4-14).
	11b. Lamp burned out.	11b. Replace lamp (paragraph 4-7).

TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
11. (cont)	11c. Relays inoperable.	11c. Check K57 (in lamp power supply compartment).
12. Liquid gate does not flow (figure 3-20 and 1137PS1)	12a. Flow rate adjusting needle valves shut off.	12a. Open needle valve specified number of turns (figures 4-1 and 1-3).
	12b. No liquid in the dispensing tank.	12b. Fill tank.
	12c. Insufficient air pressure in dispensing tank.	12c. Check dispensing tank pressure regulator. Should read 5 psi.
	12d. Spray solenoid valves LV13 and/or LV14 inoperable.	12d. Check that valves operate.
	12e. Relays inoperable.	12e. Check K34.
13. Teletype tape reader won't start	13a. 1A3A8 FFA4-115 is set.	13a. Check 1A3A8 - A115 TP1; if '1' either FFA4 is faulty or reset gate card 116 is faulty.
	13b. 1A3A8 K3-RR107 is open.	13b. Replace card 107.

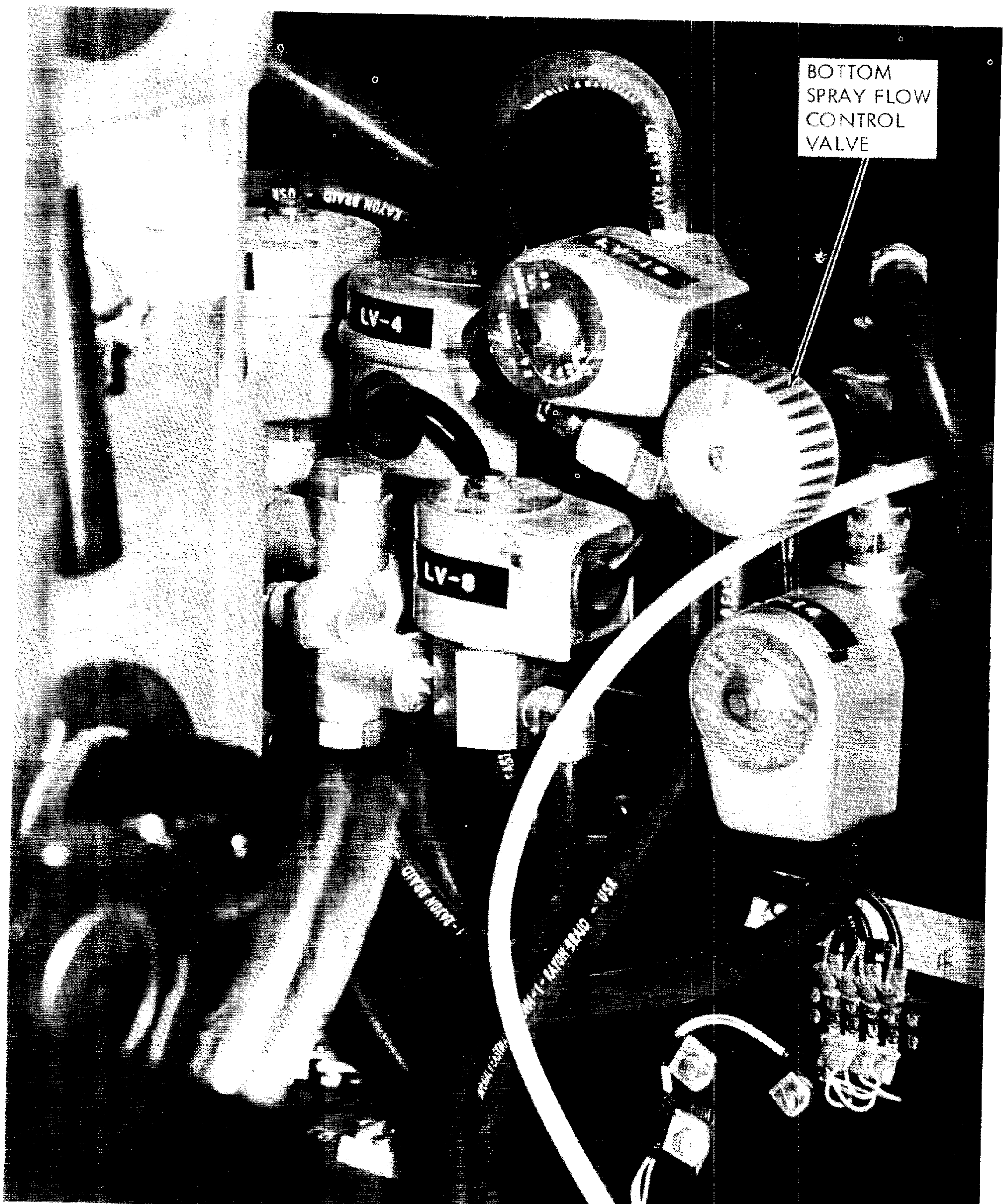

Figure 4-1. Print Console, Inner Right Front View

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TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
14. Teletype tape reader won't stop at end of tape message	14a. 1A3A8 FFA4-115 is reset. 14b. 1A3A8 loss of synch pulse or TWX synch signal.	14. Check 1A3A8-A115 TP1; if '0', monitor 115 TP3; if '0', check IS detector and synch pulse circuitry.
15. Long parity error when tape data is correct	15. SOM or EOT detectors faulty.	15a. 1A3A8-115 TP2; if '0', check SOM detector. 15b. Check 223 TP4; if '0', check EOT detector.
16. Y servo won't position	16. Malfunction of memory system or memory control. Loss of write or read commands.	16. Refer to table VII. Address out should equal decimal 7 in binary; if so, problem is in servo control. If not, determine if memory was loaded (see Memory Manual).
17. Y servo won't position	17a. 1A3A6 no data stored in 20-bit register. 17b. Faulty reed relay 1A3A6-X121. 17c. Faulty auto/man relay K1 in 1A3A1.	17a. Refer to table IV. 17b. Change card 121. 17c. Change relay K1.

TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
18. Az servo won't position	18a. Loss of Y complete pulse or level. 18b. No data stored in 1A3A6 20-bit register. 18c. Faulty reed relay.	18a. Check 1A3A6-325 TP4 for '1'. 18b. Refer to table IV. 18c. Change card 121.
19. X servo won't position	19a. Loss of Az complete signal. 19b. Repeat for Y or Az.	19a. 1A3A6-325 TP3 for '1'. 19b. Repeat for Y or Az.
20. Any servo nulls at the wrong position	20a. 1A3A6 false data stored in 20-bit register. 20b. Faulty comparator.	20a. Refer to table IV. 20b. For faulty bits, probably defective AND gate, 1 - 20.
21. Security won't position	21a. No data in storage flip-flops. 21b. Faulty reed relay.	21a. Check 1A3A7-118 TP1, TP2, and TP3 and 1A3A7-119 TP4. 21b. Check 1A3A7 cards 317 and 316.
22. Prints required display shows 00 for auto but displays correct numbers in manual mode	22. No data in storage flip-flops.	22. Check 1A3A7-125 TP1, through TP4 and 1A3A7-201 TP1, through TP4.

TABLE VI. TROUBLESHOOTING (cont)

SYMPTOM	PROBABLE CAUSE	CORRECTION
23. Data master carriage does not move to align position.	23a. 1A3A6 FFA1, A2-313 not resetting. 23b. Faulty reed relay K5-316. 23c. Faulty relays K48 and K49 on 1A2A2.	23a. Check 1A3A6-313 TP3 and TP4. 23b. Change 1A3A6-316. 23c. Change relays.
24. Data master carriage does not stop and return to complete position	24. Faulty reed relay K6-316.	24. Change 1A3A6-316.
25. Font wheel does not move	25a. Faulty SOM read detector. 25b. Faulty flip-flop.	25a. Check that 1A3A7-205 TP1 is '1'. 25b. Check that 1A3A7-111 TP4 is '0'.

TABLE VII. TEST POINTS

TIMING AND DATA LOGIC CARD

TP				
TP	1*	Cycle Complete Output	9	Data Out Bit 5
	2*	X - Y Write	10	Data Out Bit 7
	3*	X - Y Read	11*	D. R. Reset pulse
	4*	Data Strobe pulse	12*	+ Strobe pulse
	5	Data Out Bit 4	13	Data Out Bit 2
	6*	Inhibit Control	14	Data Out Bit 6
	7*	Data Out Bit 1	15	Data Out Bit 8
	8	Data Out Bit 3	16	Ground

ADDRESS AND SELECTION LOGIC CARD

TP	1	Address Out 2^5	9	Address Out 2^2
	2	Address Out 2^4	10	Address Out 2^6
	3	Not Used	11	Address Out 2^1
	4		12	Not Used
	5		13	Address Out 2^7
	6	Not Used	14*	Address Out 2^0
	7	Address Out 2^3	15	Address Out 2^8
	8	Not Used	16	+12 V Drive Supply (Y)

CORE MATRIX CARD

TP	1	Sense Preamp Out Bit 5	9*	Inhibit Line Bit 1
	2	Sense Preamp Out Bit 6	10	Inhibit Line Bit 4
	3	Sense Preamp Out Bit 7	11	Inhibit Line Bit 3
	4	Sense Preamp Out Bit 8	12	Inhibit Line Bit 2
	5	Inhibit Line Bit 6	13*	Sense Preamp Out Bit 1
	6	Inhibit Line Bit 8	14	Sense Preamp.Out Bit 2
	7	Inhibit Line Bit 5	15	Sense Preamp Out Bit 3
	8	Inhibit Line Bit 7	16	Sense Preamp Out Bit 4

* Test points shown on timing diagram in Memory System Manual

4-3. LAMP REPLACEMENT

4-4. FRONT PANEL LAMPS. The front panel indicator lamps are accessible from the front panel by removing the indicator screen. The lamps are easily removed with the lamp extractor tool found in the storage drawers of the electronics console. Power must be turned off when replacing these lamps because of the danger of shorting out the power supply with the extractor tool. All front panel lamps are type 327 except for 1A1A4 DS1 EXP ERROR, which is type NE2J. The illuminated counter display lamps (type 330) are replaced from the rear by removing the front panel.

4-5. DATA RECORDING LAMP. Access to the data recording lamp is through the back flap cover. Release the data master carriage by removing the locking screw that secures the carriage to the drive tapes. <u>Do not attempt to move the data master carriage without removing this screw,</u> otherwise the drive tapes will be severely damaged. When the carriage is released from the drive tapes, push it to the left until the data recording lamp access cover is clear. Remove this cover. On the right side of the data recording housing there is a split clamp holding the lamp socket in place. Loosen the clamp by loosening the hex-head screw on the top of the clamp. Now the lamp and socket may be removed together. Replace the lamp and place the lamp with socket back into the housing. Note that the lamp socket is keyed so that it will go back into its securing clamp only one way. The data recording lamp is a Chicago Miniature CM8-45.

4-6. SECURITY CLASSIFICATION LAMPS. Unscrew the light cap and remove the cover. On pulling the security classification cylinder straight up, the lamps (Chicago Miniature CM8-362) are visible. On putting the security classification cylinder back, note that the keyway is properly seated.

4-7. XENON EXPOSURE LAMP.

WARNING

> The exposure lamp contains gas under high pressure even when cold, so under no circumstances remove while it is still hot. When removing a cold lamp proper precautions must be taken to avoid injury in the event that the lamp ruptures while it is being handled.

4-8. When installing a new lamp make certain that there are no finger prints on the quartz envelope. These will char and turn black under operation creating hot spots that may fracture the envelope. To replace the lamp, rotate the film drive to the zero position and open the print console loading doors. The lamp access cover can now be seen framed by the opening in the center column near the floor. Before removing the access cover make certain all power is off. Remove the access cover, and after ascertaining that the lamp is cool, grasp the protective tube (the one with the fins) and pull straight out. Remove the bottom cap of the protective tube and slide the lamp out. On reinserting the new lamp note the polarity markings on the ends. Insert + end first and reinstall the protective tube so the + end of the lamp is up. To reinstall the protective tube into the light housing, push it straight in, and when all the way on the mounting clips push the protective tube down slightly to properly align the lamp.

4-9. CLEANING.

4-10. CHIP HOLDER SUPPLY. The teflon tracks in the bottom of the chip holder supply must be cleaned approximately once a week. Clean with a damp cloth only.

4-11. CHIP DROP ROLLERS. The chip drop rubber rollers should be cleaned once a day with a suitable material, such as Freon to remove finger prints and dust.

4-12. FILM METERING ROLLERS. The film metering rollers should be cleaned as needed to prevent an excessive buildup of dirt which might affect the X servo accuracy.

4-13. ADJUSTMENTS.

4-14. XENON LAMP POWER SUPPLY SPARK GAP (figure 4-2). If the Xenon lamp does not light, and the igniting arc can not be seen in the lamp power supply igniter assembly, this probably means that the spark gap needs adjusting. Turn the screw in the access hole marked GAP ADJ. 1/4 turn clockwise. This adjustment may be made as needed. When no further adjustment can be made, replace the spark gap.

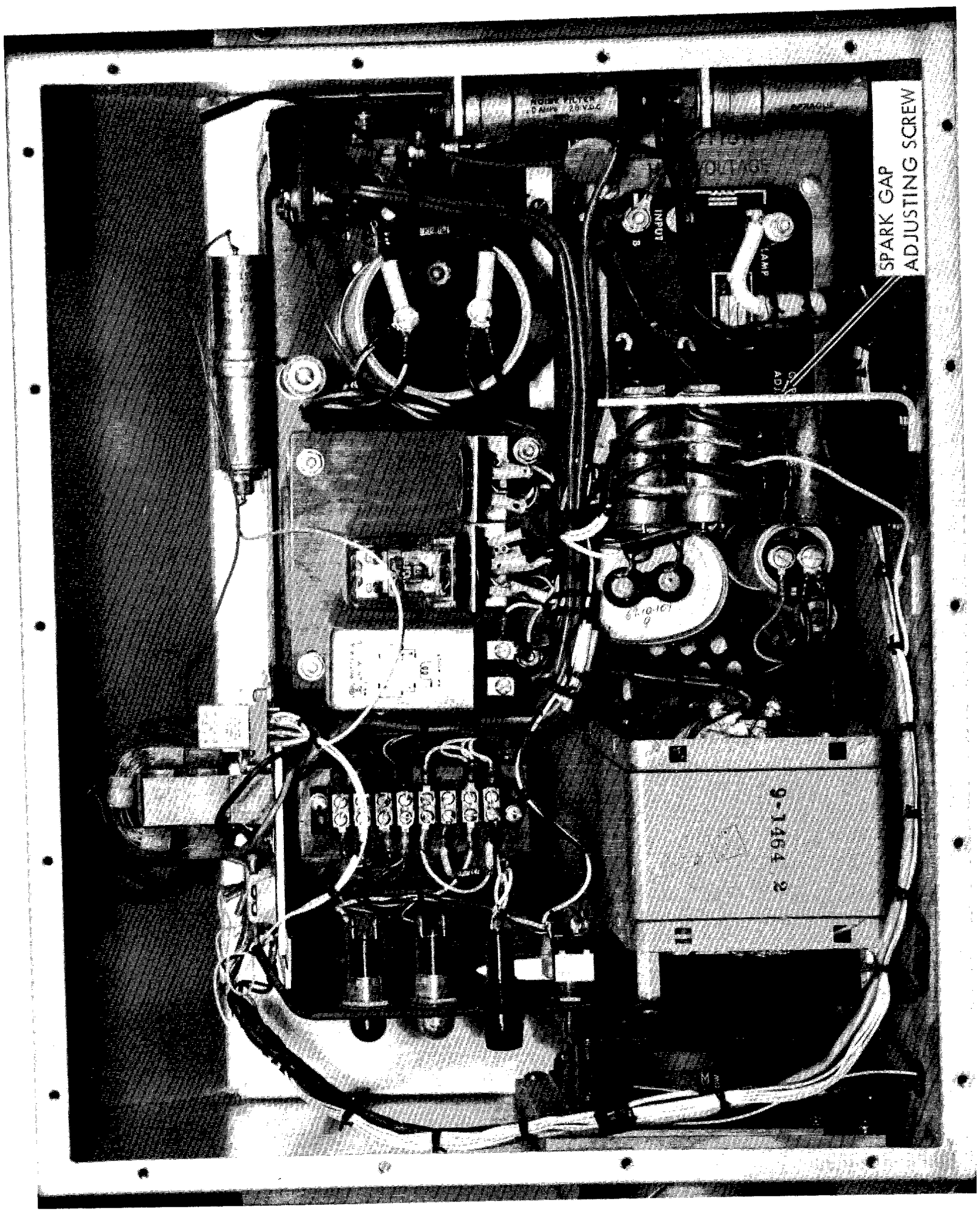

Figure 4-2. Xenon Lamp Power Supply

SECTION V

DRAWINGS

5-1. Additional schematics not included in this manual which might prove helpful in troubleshooting are as follows:

1137SD1	Electronic Console Schematic Diagram
1137SD2	Magazine Schematic Diagram
1137SD3	Relay Chassis Schematic Diagram
1137SD4	Digital Power Supply Schematic Diagram
1137SD5	Upper Left Front Panel
1137SD6	Lower Left Front Panel
1137SD7	Upper Right Front Panel
1137SD8	Lower Right Front Panel
1137SD9	Servo Drawer Schematic Diagram
1137SD10	28 VDC Power Supply
1137SD11	AEC Drawer
1137SD13	Print Console
1137PS1	Plumbing Schematic

5-2. The following list correlates the logic control drawings and functions discussed in Section III:

1137LCD20	Function	Section
Sheet 1	Word Detectors	Data Input (figure 3-23)
	IS detector	Data Input (figure 3-23)
	TWX data lines	Data Input (figure 3-23)
	Synch Pulse	Data Input (figure 3-23)
Sheet 2	Word Parity	Data Input (figure 3-23)
	STOP TWX	Data Input (figure 3-23)
	Character Hammers Control	Character Generator (figure 3-31)
	Read Commands, SOM-DC4	Character Generator (figure 3-31)

1137LCD20	Function	Section
Sheet 3	Master Parity	Data Input (figure 3-23)
Sheet 4	SOM-EOT Count	Data Input (figure 3-23)
	Memory Input Gates	Data Input (figure 3-23)
	Level Converters	Data Input (figure 3-23)
1137LCD21		
Sheet 1	Schmitt Triggers	Character Generator (figure 3-31)
	7-Bit Comparator	Character Generator (figure 3-31)
	EQ · SET FF	Character Generator (figure 3-31)
	Data Master Stepper Motor Control	Character Generator (figure 3-31)
	Film Footage Count Control	Miscellaneous
Sheet 2	Prints Decade Count	Prints (figure 3-30)
	8-Bit Comparator	Prints (figure 3-30)
	35, 70 Count Detector	Prints (figure 3-30)
Sheet 3	Prints Reqd 8-Bit Register	Prints (figure 3-30)
	Thumbwheel SW outputs	Prints (figure 3-30)
	Man/Auto Relays	Prints (figure 3-30)
	Prints Reqd Display Drive	Prints (figure 3-30)
Sheet 4	Prints Printed Display Drivers	Prints (figure 3-30)
Sheet 5	Memory Control	Memory Control (figure 3-25)
	Logic Reset	Miscellaneous
Sheet 6	IS Shift Register	Data Output (figure 3-26)
	Level Conversion	Data Output (figure 3-26)
	Detectors +, -, IS	Data Output (figure 3-26)
	Detectors, space	Data Output (figure 3-26)
	Timing Generator	Data Output (figure 3-26)

1137LCD21	Function	Section
Sheet 7	Detectors SOM, EOA	Data Output (figure 3-26)
	Detectors EOT, DC4	Data Output (figure 3-26)
	Crona gate	Data Output (figure 3-26)
	Servo gate	Data Output (figure 3-26)
	Prints gate	Data Output (figure 3-26)
	Security gate	Data Output (figure 3-26)
1137LCD22		
Sheet 1	5-Bit Shift Register	Servo Control (figure 3-27)
	Timing	Servo Control (figure 3-27)
	Reed Relays	Servo Control (figure 3-27)
Sheets 2 - 5, 7	21-Bit Register	Servo Control (figure 3-27)
	20-Bit Comparator	Servo Control (figure 3-27)
Sheet 6	Reed Relays Decoding	Security (figure 3-29)
	Data Master Carriage Control	Character Generator (figure 3-31)